

State of Hawaii
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Aquatic Resources
Honolulu, Hawaii 96813

August 12, 2010

Board of Land
and Natural Resources
Honolulu, Hawaii

Request for Authorization and Approval to Issue a Papahānaumokuākea Marine National
Monument Research Permit to Dr. Russell Brainard, NOAA Pacific Islands Fisheries
Science Center, for Access to State Waters to Conduct Reef Assessment and Monitoring
Activities

The Division of Aquatic Resources (DAR) hereby submits a request for your authorization and approval for issuance of a Papahānaumokuākea Marine National Monument research permit to Dr. Russell Brainard, Chief, Coral Reef Ecosystem Division, Pacific Islands Fisheries Science Center, pursuant § 187A-6, Hawaii Revised Statutes (HRS), chapter 13-60.5, Hawaii Administrative Rules (HAR), and all other applicable laws and regulations.

The research permit, as described below, would allow entry and research activities to occur in the Papahānaumokuākea Marine National Monument (Monument), including the NWHI State Marine Refuge and the waters (0-3 nautical miles) surrounding the following sites:

- Nihoa Island
- Necker Island (Mokumanamana)
- French Frigate Shoals
- Gardner Pinnacles
- Maro Reef
- Laysan Island
- Lisianski Island, Neva Shoal
- Pearl and Hermes Atoll
- Kure Atoll

The activities covered under this permit would occur between August 27, 2010 and September 30, 2010.

The proposed activities are a renewal of work previously permitted and conducted in the Monument.

INTENDED ACTIVITIES

The applicant proposes to conduct reef assessment and monitoring activities throughout the Monument, as part of the Pacific Reef Assessment and Monitoring Program (RAMP).

The primary research groups of the program are algae, coral and coral disease, invertebrates, fish, and oceanographic and water sampling. Activities to assess these groups would include rapid ecological assessments of corals, macro-invertebrates, fish, and algae; spatial towed-diver surveys of benthic composition and the abundance and distribution of macro-invertebrate taxa and large fish; passive acoustic monitoring of biotic and anthropogenic sounds; and multi-platform oceanographic and water quality monitoring using shipboard surveys and moored instrument arrays.

While the monitoring would primarily be visual observations and photo documentation, some collections are also being requested. Collections are summarized below:

- 1 quart-sized Ziplock bag of algae per REA (monitoring site), when necessary for identification purposes, up to 66 bags total.
- Additional 10 samples of each of 3 species of *Halimeda* (green algae) per REA site, up to 1980 samples total, as well as small coral rubble samples from the same sites, up to 660 samples.
- 2 Plankton tows per REA site, up to 122 tows total
- Up to 130 coral samples (up to 7cm in size) total, plus samples of coral exhibiting new diseases if encountered
- Up to 21 coral core samples total (cores are 2.5cm x 5-40cm, collected by pneumatic drill)
- Up to 1342 water samples total

The applicant also proposes to retrieve and replace Autonomous Reef Monitoring Structures (ARMS) currently in the field. Retrieval would include collection of organisms that have colonized on the structures.

RAMP activities would also include the servicing and/or installation of various oceanographic instrument and markers. The applicant requests to install up to 60 permanent transect markers at long term monitoring sites. Transect markers consist of cable ties, a plastic float, and when necessary, eye-bolt anchors. While most oceanographic instrumentation activities would consist of servicing or replacing existing units, the applicant is requesting the new installation of up to 500 CAUs (calcification acidification units). These units consist of a pair of 10cmx10cm poly vinyl chloride plates attached to the reef, and are typically deployed as a set of 5 per REA site.

It should be noted that while the applicant initially requested to collect voucher specimens of coral species being petitioned for inclusion as Endangered Species, this request has been withdrawn. In addition, initial requests to collect non-coral invertebrates and voucher fish specimens have also been withdrawn.

The activities directly support the Monument Management Plan's action plan 3.1.1 – Marine Conservation Science (through strategy MCS-1.2: Continue monitoring of shallow-water coral reef ecosystems to protect ecological integrity).

The activities described above may require the following regulated activities to occur in State waters:

- ☒ Removing, moving, taking, harvesting, possessing, injuring, disturbing, or damaging any living or nonliving monument resource
- ☒ Drilling into, dredging, or otherwise altering the submerged lands other than by anchoring a vessel; or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands
- ☒ Touching coral, living or dead
- ☒ Swimming, snorkeling, or closed or open circuit SCUBA diving within any Special Preservation Area or Midway Atoll Special Management Area

REVIEW PROCESS

The permit application was sent out for review and comment to the following scientific and cultural entities: Hawaii Division of Aquatic Resources, Hawaii Division of Forestry and Wildlife, Papahānaumokuākea Marine National Monument (NOAA/NOS), NOAA Pacific Islands Regional Office (NOAA-PIRO), United States Fish and Wildlife Service Hawaiian and Pacific Islands National Wildlife Refuge Complex Office, and the Office of Hawaiian Affairs (OHA). In addition, the permit application has been posted on the Monument Web site since June 21st, giving the public an opportunity to comment. The application was posted within 40 days of its receipt, in accordance with the Monument's Public Notification Policy.

Comments received from the scientific community are summarized as follows:

Scientific reviews support the acceptance of this application.

The following concerns were raised. Applicant responses are noted below.

1. How are survey sites chosen?

- The applicant reports that the benthic team revisits long-term monitoring sites established in 2003 by CRED, NWHI-CRER (the precursor to PMNM), Oceanic Institute, and the University of Hawaii.

Comments received from the Native Hawaiian community are summarized as follows:

Cultural reviews support the acceptance of this application. No concerns were raised.

Comments received from the public are summarized as follows:

No comments were received from the public on this application.

Additional reviews and permit history:

Are there other relevant/necessary permits or environmental reviews that have or will be issued with regard to this project? (e.g. MMPA, ESA, EA) Yes ☒ No ☐

If so, please list or explain:

- All activities have been analyzed in a Programmatic Environmental Assessment (PEA) for research activities conducted by the Coral Reef Ecosystem Division/Pacific Islands Fisheries Science Center/NOAA, which resulted in a finding of no significant impact (FONSI).
- The Department has made an exemption determination for this permit in accordance chapter 343, HRS, and Chapter 11-200, HAR. See Attachment ("DECLARATION OF EXEMPTION FROM THE PREPARATION OF AN ENVIRONMENTAL ASSESSMENT UNDER THE AUTHORITY OF CHAPTER 343, HRS AND CHAPTER 11-200 HAR, FOR PAPAĦANAUMOKUĀKEA MARINE NATIONAL MONUMENT RESEARCH PERMIT TO DR. RUSSELL BRAINARD, NOAA, PACIFIC ISLANDS FISHERIES SCIENCE CENTER, FOR ACCESS TO STATE WATERS TO CONDUCT REEF ASSESSMENT AND MONITORING ACTIVITIES UNDER PERMIT PMNM-2010-052")

Has Applicant been granted a permit from the State in the past? Yes ☒ No ☐
If so, please summarize past permits:

- The Applicant was granted State permits for similar activities in 2006 and 2008. (DLNR/NWHI06R013 and PMNM-2008-062). In addition, Randall Kosaki and Elizabeth Keenan were issued permits to carry out similar activities in 2007 and 2009 respectively (PMNM-2007-048 and PMNM-2009-058).

Have there been any a) violations: Yes ☐ No ☒
b) Late/incomplete post-activity reports: Yes ☐ No ☒

Are there any other relevant concerns from previous permits? Yes ☐ No ☒

STAFF OPINION

DAR staff is of the opinion that Applicant has properly demonstrated valid justifications for his application and should be allowed to enter the NWHI State waters and to conduct the activities therein as specified in the application with certain special instructions and conditions, which are in addition to the Papahānaumokuākea Marine National Monument Research Permit General Conditions. All suggested special conditions have been vetted through the legal counsel of the Co-Trustee agencies (see Recommendation section).

MONUMENT MANAGEMENT BOARD OPINION

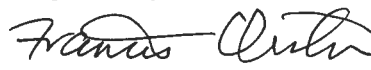
The MMB is of the opinion that the Applicant has met the findings of Presidential Proclamation 8031 and this activity may be conducted subject to completion of all compliance requirements. The MMB concurs with the special conditions recommended by DAR staff.

RECOMMENDATION

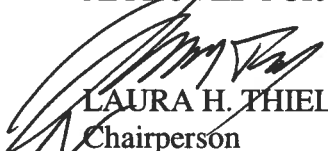
That the Board authorize and approve a Research Permit to Dr. Russell Brainard, Pacific Islands Fisheries Science Center, with the following special conditions:

1. This permit is not to be used for nor does it authorize the sale of collected organisms. Under this permit, the authorized activities must be for noncommercial purposes not involving the use or sale of any organism, by-products, or materials collected within the Monument for obtaining patent or intellectual property rights.
2. The permittee may not convey, transfer, or distribute, in any fashion (including, but not limited to, selling, trading, giving, or loaning) any coral, live rock, or organism collected under this permit without the express written permission of the Co-Trustees.
3. To prevent introduction of disease or the unintended transport of live organisms, the permittee must comply with the disease and transport protocol attached to this permit.
4. Tenders and small vessels must be equipped with engines that meet EPA emissions requirements.
5. Refueling of tenders and all small vessels must be done at the support ships and outside the confines of lagoons or near-shore waters in the State Marine Refuge.
6. No fishing is allowed in State Waters except as authorized under State law for subsistence, traditional and customary practices by Native Hawaiians.

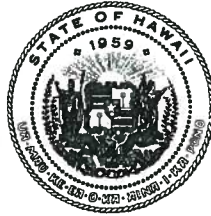
Respectfully submitted,


for Administrator

APPROVED FOR SUBMITTAL


LAURA H. THIELEN
Chairperson

LINDA LINGLE
GOVERNOR OF HAWAII



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

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LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

KEN C. KAWAHARA
DEPUTY DIRECTOR - WATER

RUSSELL TSUJI
DEPUTY DIRECTOR - LAND

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAOHOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

TO: Division of Aquatic Resources File

THROUGH: Laura H. Thielen, Chairperson

FROM: Francis Oishi
Division of Aquatic Resources

A handwritten signature in black ink, appearing to be "FO", is written next to the name Francis Oishi.

DECLARATION OF EXEMPTION FROM THE PREPARATION OF AN ENVIRONMENTAL ASSESSMENT
UNDER THE AUTHORITY OF CHAPTER 343, HRS AND CHAPTER 11-200 HAR, FOR
PAPAHĀNAUMOKUĀKEA MARINE NATIONAL MONUMENT RESEARCH PERMIT TO DR. RUSSELL
BRAINARD, NOAA, PACIFIC ISLANDS FISHERIES SCIENCE CENTER, FOR ACCESS TO STATE
WATERS TO CONDUCT REEF ASSESSMENT AND MONITORING ACTIVITIES
UNDER PERMIT PMNM-2010-052.

The following permitted activities are found to be exempted from preparation of an environmental assessment under the authority of Chapter 343, HRS and Chapter 11-200, HAR:

Project Title:

Papahānaumokuākea Marine National Monument Research Permit to Dr. Russell Brainard, NOAA Pacific Islands Fisheries Science Center, for Access to State Waters to Conduct Reef Assessment and Monitoring Activities

Permit Number: PMNM-2010-052

Project Description:

The research permit application, as described below, would allow entry and activities to occur in Papahānaumokuākea Marine National Monument (Monument), including the NWHI State waters between August 27, 2010 and September 30, 2010.

This is an effort to conduct reef assessment and monitoring activities throughout the Monument, as part of the Pacific Reef Assessment and Monitoring Program (RAMP). The primary research groups of the program are algae, coral and coral disease, invertebrates, fish, and oceanographic and water sampling. Activities to assess these groups would include rapid ecological assessments of corals, macro-invertebrates, fish, and algae; spatial towed-diver surveys of benthic composition and the abundance and distribution of macro-invertebrate taxa and large fish; passive acoustic monitoring of biotic and anthropogenic sounds; and multi-platform oceanographic and water quality monitoring using shipboard surveys and moored instrument arrays.

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The proposed activities are in direct support of the Monument Management Plan's priority management needs 3.1 – Understanding and Interpreting the NWHI, through action plan 3.1.1 – Marine Conservation Science. This action plan includes a strategy to “Continue monitoring of shallow-water coral reef ecosystems to protect ecological integrity”.

Activities to support marine conservation science in the NWHI are addressed in the Monument Management Plan Environmental Assessment (December 2008) which resulted in a FONSI, or a finding of no significant impact. This EA specifically covers field activities, such as those being proposed, that will “characterize shallow-water marine habitats” (PMNM MMP Vol 2, p.70).

In addition, activities have been analyzed in a Programmatic Environmental Assessment (PEA) for research activities conducted by the Coral Reef Ecosystem Division/Pacific Islands Fisheries Science Center/NOAA, which also resulted in a FONSI.

Consulted Parties:

The permit application was sent out for review and comment to the following scientific and cultural entities: Hawaii Division of Aquatic Resources, Hawaii Division of Forestry and Wildlife, Papahānaumokuākea Marine National Monument (NOAA/NOS), NOAA Pacific Islands Regional Office (NOAA-PIRO), United States Fish and Wildlife Service Hawaiian and Pacific Islands National Wildlife Refuge Complex Office, and the Office of Hawaiian Affairs (OHA). In addition, the permit application has been posted on the Monument Web site since June 21st, giving the public an opportunity to comment. The application was posted within 40 days of its receipt, in accordance with the Monument's Public Notification Policy.

Exemption Determination:

After reviewing HAR § 11-200-8, including the criteria used to determine significance under HAR § 11-200-12, DLNR has concluded that the activities under this permit would have minimal or no significant effect on the environment and that issuance of the permit is categorically exempt from the requirement to prepare an environmental assessment based on the following analysis:

1. All activities associated with this permit, including monitoring and collection activities, have been evaluated as a single action. As a preliminary matter, multiple or phased actions, such as when a group of actions are part of a larger undertaking, or when an individual project is precedent to or represents a commitment to a larger project, must be grouped together and evaluated as a single action. HAR § 11-200-7. Since this permit involves an activity that is precedent to a later planned activity, i.e. the continuation of reef monitoring activities, the categorical exemption determination here will treat all planned activities as a single action.

2. The Exemption Class for Scientific Research with no Serious or Major Environmental Disturbance Appears to Apply. Chapter 343, HRS, and § 11-200-8, HAR, provide for a list of classes of actions exempt from environmental assessment requirements. HAR §11-200-8.A.5. exempts the class of actions which involve “basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource.” This exemption class has been interpreted to include “surveys, censuses, inventories, studies, photographing, recording, sampling, collection, culture and captive propagation of aquatic biota”, such as those being proposed.

The proposed collection activities here appear to fall squarely under the exemption class #5, exempt item #5 as described under the former Fish and Game Division exemption list published

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in January 19, 1976. As discussed below, no significant disturbance to any environmental resource is anticipated in the sampling of Monument resources. Thus, so long as the below considerations are met, an exemption class should include the action now contemplated.

3. Cumulative Impacts of Actions in the Same Place and Impacts with Respect to the Potentially Particularly Sensitive Environment Will Not be Significant. Even where a categorical exemption appears to include a proposed action, the action cannot be declared exempt if “the cumulative impact of planned successive actions in the same place, over time, is significant, or when an action that is normally insignificant in its impact on the environment may be significant in a particularly sensitive environment.” HAR § 11-200-8.B. To gauge whether a significant impact or effect is probable, an exempting agency must consider every phase of a proposed action, any expected primary and secondary consequences, the long-term and short-term effects of the action, the overall and cumulative effect of the action, and the sum effects of an action on the quality of the environment. HAR § 11-200-12. Examples of actions which commonly have a significant effect on the environment are listed under HAR § 11-200-12.

The activities would be a continuation of work previously conducted by this applicant and others, which involved monitoring and collection activities to characterize shallow-water marine habitats. Permits have been issued for this study each year since 2006, and it is likely that future requests for permits will be received to continue this work. No deleterious effects have resulted from these activities in the past. With this in mind, significant cumulative impacts are not anticipated as a result of this activity, and numerous safeguards further ensure that the potentially sensitive environment of the project area will not be significantly affected. All activities would be conducted in a manner compatible with the management direction of the Monument Proclamation in that the activities do not diminish monument resources, qualities, and ecological integrity, or have any indirect, secondary, cultural, or cumulative effects. The joint permit review process did not reveal any anticipated indirect or cumulative impacts, nor did it raise any cultural concerns, that would occur as a result of these activities.

The activities would be conducted from the NOAA Ship HI’IALAKAI (PMNM-2010-007) during its late August/September cruise. No other permitted activities are anticipated to take place on this cruise. The NOAA Ships McARTHUR II (PMNM-2010-054 pending) and OSCAR ELTON SETTE (PMNM-2010-006) may also be in the Monument during this time frame to support cetacean survey activities (PMNM-2010-053 pending). The culmination of these permits, and their disparate activities, occurring throughout the Monument over a month-long period, is not anticipated to have significant cumulative impacts.

Since no significant cumulative impacts or significant impacts with respect to any particularly sensitive aspect of the project area are anticipated, the categorical exemptions identified above should remain applicable.

4. Overall Impacts will Probably be Minimal and Insignificant Any foreseeable impacts from the proposed activity will probably be minimal, and further mitigated by general and specific conditions attached to the permit. Specifically, all research activities covered by this permit will be carried out with strict safeguards for the natural, historic, and cultural resources of the Monument as required by Presidential Proclamation 8031, other applicable law and agency policies and standard operating procedures.

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Conclusion. Upon consideration of the permit to be approved by the Board of Land and Natural Resources, the potential effects of the above listed project as provided by Chapter 343, HRS and Chapter 11-200 HAR, have been determined to be of probable minimal or no significant effect on the environment and exempt from the preparation of an environmental assessment.

Laura H. Thielen
Board of Land and Natural Resources

Date

Papahānaumokuākea Marine National Monument
RESEARCH Permit Application

NOTE: *This Permit Application (and associated Instructions) are to propose activities to be conducted in the Papahānaumokuākea Marine National Monument. The Co-Trustees are required to determine that issuing the requested permit is compatible with the findings of Presidential Proclamation 8031. Within this Application, provide all information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Papahānaumokuākea Marine National Monument (Monument).*

ADDITIONAL IMPORTANT INFORMATION:

- Any or all of the information within this application may be posted to the Monument website informing the public on projects proposed to occur in the Monument.
- In addition to the permit application, the Applicant must either download the Monument Compliance Information Sheet from the Monument website OR request a hard copy from the Monument Permit Coordinator (contact information below). The Monument Compliance Information Sheet must be submitted to the Monument Permit Coordinator after initial application consultation.
- Issuance of a Monument permit is dependent upon the completion and review of the application and Compliance Information Sheet.

INCOMPLETE APPLICATIONS WILL NOT BE CONSIDERED

Send Permit Applications to:

Papahānaumokuākea Marine National Monument Permit Coordinator

6600 Kalaniana'ole Hwy. # 300

Honolulu, HI 96825

nwhiperm@noaa.gov

PHONE: (808) 397-2660 FAX: (808) 397-2662

SUBMITTAL VIA ELECTRONIC MAIL IS PREFERRED BUT NOT REQUIRED. FOR ADDITIONAL SUBMITTAL INSTRUCTIONS, SEE THE LAST PAGE.

Papahānaumokuākea Marine National Monument Permit Application Cover Sheet

This Permit Application Cover Sheet is intended to provide summary information and status to the public on permit applications for activities proposed to be conducted in the Papahānaumokuākea Marine National Monument. While a permit application has been received, it has not been fully reviewed nor approved by the Monument Management Board to date. The Monument permit process also ensures that all environmental reviews are conducted prior to the issuance of a Monument permit.

Summary Information

Applicant Name: Russell E. Brainard, Ph.D.

Affiliation: National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center Chief (PIFSC), Coral Reef Ecosystem Division (CRED)

Permit Category: Research

Proposed Activity Dates: 08/27/10- 09/30/10

Proposed Method of Entry (Vessel/Plane): NOAA Ship Hi'ialakai

Proposed Locations: Shallow water reefs (<30m) of the Monument including the reefs associated with: Kure Atoll, Pearl & Hermes Atoll, Midway Atoll, French Frigate Shoals, Lisianski Island, Laysan Island, Nihoa Island, Necker Island, Gardner Pinnacles and Maro Reef.

Estimated number of individuals (including Applicant) to be covered under this permit:

26

Estimated number of days in the Monument: 36

Description of proposed activities: (complete these sentences):

a.) The proposed activity would...
conduct reef assessment and monitoring activities throughout the islands and atolls of the Papahānaumokuākea Marine National Monument. These efforts would contribute to continuing research providing scientific information needed to support ecosystem approaches to the management of coral reef systems of the Monument and areas across the Pacific region. The primary focus of the multi-institutional team of scientists, led by NOAA's CRED, would focus on collaborating with local agencies to implement the Pacific Reef Assessment and Monitoring Program (RAMP).

b.) To accomplish this activity we would
use monitoring efforts including rapid ecological assessments of corals, macro-invertebrates, fish, and algae to species or genus level using multiple methods; spatial towed-diver surveys of benthic composition and the abundance and distribution of ecologically and economically important macro-invertebrate taxa and large fish; passive acoustic monitoring of biotic and

anthropogenic sounds; and multi-platform oceanographic and water quality monitoring using shipboard surveys, moored instrument arrays, and satellite remote sensing.

c.) This activity would help the Monument by ...
the use of consistent interdisciplinary methods across this vast region allowing for an opportunity to perform bio geographic and ecological comparative analyses of diverse ecological, environmental, and oceanographic gradients. Patterns of variability of fish biomass, coral disease, diversity, and other reef metrics are paramount to assessing an ecological niche as valuable as Papahānaumokuākea Marine National Monument.

Other information or background: CRED conducts integrated, multidisciplinary, ecosystem research, habitat mapping, and long-term monitoring of coral reef ecosystems in the U.S.-affiliated Pacific Islands. CRED's work is a key component of NOAA's Coral Reef Conservation Program (CRCP). CRED scientists describe, map, and monitor coral reef ecosystems. The program's approach is to apply a suite of standardized methods- including ecological assessments, oceanographic and water quality measurements, and benthic habitat mapping, to improve understanding of the spatial and temporal processes influencing the health of coral reef ecosystems throughout the region. The knowledge gained is shared with resource managers and various public stakeholders to improve decision-making for the long-term conservation and management of coral reef resources.

Section A - Applicant Information

1. Applicant

Name (last, first, middle initial): Russell E. Brainard, Ph.D.

Title: Chief, Coral Reef Ecosystem Division, NOAA Pacific Islands Fisheries Science Center

1a. Intended field Principal Investigator (See instructions for more information):

Russell E. Brainard, Ph.D. (See attached CV)

2. Mailing address (street/P.O. box, city, state, country, zip):

[REDACTED]

[REDACTED]

[REDACTED]

[REDACTED]

For students, major professor's name, telephone and email address:

3. Affiliation (institution/agency/organization directly related to the proposed project):

NOAA Pacific Islands Fisheries Science Center, Coral Reef Ecosystem Division

4. Additional persons to be covered by permit. List all personnel roles and names (if known at time of application) here (e.g. John Doe, Research Diver; Jane Doe, Field Technician):

Fish Research Team

1. TBD

2. TBD

3. TBD

4. TBD

Benthic Research Team

5. TBD- Coral Populations

6. TBD- Coral Disease

- 7. TBD- Invertebrates
- 8. TBD- Invertebrates (ARMS)
- 9. TBD- Lead Phycologist
- 10. TBD- Assistant Phycologist

Towed-diver Survey Team

- 11. TBD- Fish
- 12. TBD- Fish
- 13. TBD- Benthic Habitat
- 14. TBD- Benthic Habitat

Oceanographic and Mooring Team

- 15. TBD
- 16. TBD
- 17. TBD
- 18. TBD
- 19. TBD

Divemaster/Chamber Operator

- 20. TBD

Data Management/ Outreach

- 21. TBD
- 22. TBD

Section B: Project Information

5a. Project location(s):

<input checked="" type="checkbox"/> Nihoa Island	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Necker Island (Mokumanamana)	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> French Frigate Shoals	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Gardner Pinnacles	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Maro Reef			
<input checked="" type="checkbox"/> Laysan Island	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Lisianski Island, Neva Shoal	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Pearl and Hermes Atoll	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Midway Atoll	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input checked="" type="checkbox"/> Kure Atoll	<input type="checkbox"/> Land-based	<input checked="" type="checkbox"/> Shallow water	<input type="checkbox"/> Deep water
<input type="checkbox"/> Other			

NOTE: There is a fee schedule for people visiting Midway Atoll National Wildlife Refuge via vessel and aircraft.

Location Description:

CRED's multidisciplinary monitoring teams collect data in shallow water environments from surface levels to 30m deep. There are over 300 permanent transect and mooring sites in addition to the towed diver surveys throughout PMNM investigating the various coral reef environments along the forereef, backreef and lagoons. The list of positions will be submitted in the compliance form.

5b. Check all applicable regulated activities proposed to be conducted in the Monument:

- ☒ Removing, moving, taking, harvesting, possessing, injuring, disturbing, or damaging any living or nonliving Monument resource
- ☒ Drilling into, dredging, or otherwise altering the submerged lands other than by anchoring a vessel; or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands
- ☒ Anchoring a vessel
- ☐ Deserting a vessel aground, at anchor, or adrift
- ☐ Discharging or depositing any material or matter into the Monument
- ☒ Touching coral, living or dead
- ☐ Possessing fishing gear except when stowed and not available for immediate use during passage without interruption through the Monument
- ☐ Attracting any living Monument resource
- ☐ Sustenance fishing (Federal waters only, outside of Special Preservation Areas, Ecological Reserves and Special Management Areas)
- ☐ Subsistence fishing (State waters only)
- ☒ Swimming, snorkeling, or closed or open circuit SCUBA diving within any Special Preservation Area or Midway Atoll Special Management Area

6 Purpose/Need/Scope *State purpose of proposed activities:*

The Coral Reef Conservation Act of 2000 created a national program and authorized NOAA to conduct mapping, monitoring, assessment, restoration, and scientific research that benefit the understanding, sustainable use, and long-term conservation of coral reefs and coral reef ecosystems. As part of the mandate, CRED leads coral reef ecosystem monitoring efforts in the U.S. jurisdictions across the Pacific, including in PMNM. CRED proposes to continue its previous Pacific RAMP efforts in the Northwestern Hawaiian Islands by conducting coral reef ecosystem monitoring, which includes biological and oceanographic observations and benthic habitat mapping.

In order to properly manage the coral reefs and related waters of PMNM, Pacific RAMP cruises utilize several disciplines to monitor the various biota and environments. The primary research areas are listed below with accompanying descriptions (Algae 1; Coral and Coral Disease 2; Invertebrates 3; Fish 4; and Oceanographic & Water Sampling 5):

1.) Algae:

Marine algae are among the most poorly understood organisms in tropical reef ecosystems, yet without them coral reefs could not exist. Their importance to the ecosystem is staggering: algae form the base of the food chain, occupy much of the available benthic substrate, and help to oxygenate the water for animal life to thrive.

At this time, comprehensive species lists of algae are just beginning to be known for the majority of islands and banks located in the Northwestern Hawaiian Islands, and every research expedition greatly adds to our knowledge of algal diversity. Additionally, CRED is beginning studies to determine relative algal abundance at these islands, and whether it changes over time. In order for baseline information of algal diversity and abundance to be determined, collections of specimens from the field are mandatory. Essentially all algae need microscopic laboratory analysis for proper species identification, and voucher specimens for both qualitative and quantitative studies are necessary for research to be accepted by peer reviewed journals.

Objectives

- 1) Determine which macroalgal species are present in each island ecosystem and in what quantity.
- 2) Examine how algal diversity and abundance change over time.
- 3) Assess whether changes in algal populations serve as good environmental indicators of reef health.
- 4) Formulate bio geographical hypotheses about algal dispersal and evolution using qualitative and quantitative data from island groups around the Pacific.

2.) Coral:

This study is aimed at monitoring the diversity, abundance, and distribution of corals and coral diseases at established, long-term sites in PMNM. This goal is encompassed within CRED's programmatic mission: to further efforts to monitor, assess, and preserve coral reefs in the US Pacific Territories. The specific objectives of this study are achieved by implementing a combination of field surveys and lab investigations. Coral community structural parameters, including colony number, diversity, density, size class distribution, and percent cover are quantified based on field surveys at geo-referenced sites that were selected for long-term monitoring in 2004, 2006 and 2008 by a multi-disciplinary, multi-agency group of biologists and managers, aimed at providing spatial-temporal appraisals of coral reef dynamics in the region. In addition, the presence and geographic distribution of coral disease is documented and later validated/characterized with laboratory techniques. New initiatives for 2010 aimed towards understanding past and current calcification rates in scleractinian corals and other calcifying reef builders involve collecting coral cores and branches to determine growth/calcification rates using CAT-scan technology, and the installation of calcification plates. The work delineated in this permit application is relevant as it pertains to the assessment and understanding of coral reef structural integrity and

health status over time. More importantly, it enhances awareness toward the protection and preservation of critical habitats across the U.S.-affiliated Pacific.

Objectives

- 1) Continue to monitor the abundance, diversity, density, percent cover, and size class distribution of shallow water (< 20m) scleractinian corals, building upon quantitative studies that were initiated in 2002.
- 2) Assess and monitor the abundance and geographical distribution of shallow-water (< 20 m) diseases and diseased corals, building upon studies that were initiated in 2008.
- 3) Methodically describe the gross morphology of lesions in diseased corals.
- 4) Procure samples of diseased and healthy (control) coral tissues for histological studies pertaining to disease etiology.
- 5) Verify range extensions of described species of corals, and procure type specimens (if needed) for the description of new species.
- 6) Establish new permanent transect markers at previously-established long-term monitoring sites.

3.) Invertebrates:

The need for conservation of coral reef ecosystems throughout the world requires knowledge concerning species richness within and among habitats and an understanding of the factors that influence species survivorship. The collection of systematic information concerning what taxa are present is essential to understand the changes in coral reef communities and having these indices of biodiversity are crucial baselines for ongoing monitoring programs.

Historically, coral reef biodiversity assessments and monitoring programs have focused strictly on the charismatic fauna such as corals and fish even though the majority of reef biodiversity is represented by cryptic invertebrate fauna such as sponges, molluscs, echinoderms, crustaceans, annelids, bryozoans and tunicates. Proper inventory of such taxa requires two factors: physical sampling and systematic expertise. Thus, specimen collections are necessary within PMNM waters for biodiversity assessments. This project will build upon previous baseline and monitoring efforts to enhance the state of knowledge of coral reef invertebrate populations in Hawaii and in relationship to the other Pacific island areas.

Objectives

- 1) Collect both quantitative and qualitative information for species present at all sites;
- 2) Produce species inventories for all locations;
- 3) Retrieval, processing and replacement of up to 70 Autonomous Reef Monitoring Structures (ARMS) in PMNM

The non-coral marine invertebrate fauna of coral reefs represents a group of animals that are numerically dominant in their habitat and in some cases represent taxonomic groups that are only represented in the marine environment. New species are continuously being described even though coral reefs are extensively studied habitats. In addition to these new species descriptions, the expansion of knowledge concerning the ranges of known species is also an important task that is integral for the spectrum of conservation ranging from single species up to the level of ecosystems.

4.) Fish:

Quantitative assessment and monitoring of shallow reef fish assemblages is conducted around the US Pacific Islands as an integral part of the NOAA/NMFS/PIFSC Coral Reef Ecosystem Division's mission to improve our scientific understanding of these fish resources, and to contribute to the scientific basis necessary for sound management. Currently, biennial monitoring surveys are conducted at each geographic sub-region to document status and trends in reef fish assemblages. Habitat types surveyed encompass a wide range of habitats within CRED's survey domain (i.e. 0-30m hardbottom). The majority of sites are on outer reef slopes, but others are located on lagoon patch reefs, bays, back-reefs, and on shallow oceanic banks, where those are present.

Inventories and assessments of shallow reef fishes have been completed by CRED at all US Pacific Islands where access is possible, and monitoring is ongoing. Continued updating of data and analysis of this growing database will enable species-specific numerical and biomass densities to be calculated, fish assemblage structure to be described at various spatial and temporal scales, and statistical correlations to be determined. Further analysis of CRED's oceanographic and biological data will aid in understanding patterns of fish distribution and abundance as well as ecosystem associations.

Objectives:

- 1) Gather data sufficient to assess status and trends of reef fish populations.
- 2) Provide the basis for meaningful comparison of PMNM stocks with stocks in other parts of the Hawaiian archipelago.
- 3) Provide the basis needed to assess the response (or potential response) of PMNM reef fish communities to possible ecosystem impacts such as fishing, ecotourism, pollution habitat damage, sedimentation, and hurricanes.

5.) Oceanography:

Obtaining a near-continuous stream of physical and biological oceanographic data from areas that have been previously known only from sporadic, ship-based observations will better enable scientists and resource managers to characterize the regime under which coral reef ecosystems function. These systems can also provide early warnings of features, such as increased sea surface temperature, which may have impacts on the health of the coral reef ecosystem. Long-term datasets of oceanographic and environmental parameters provide important context to biological/ecological observations (obtained by NOAA, the Monument, and other partners). Passive acoustic information allows resource managers to economically monitor vessel activity and other variables at remote locations.

In conjunction with PMNM, we are requesting permission to service existing instruments and deploy additional instrumentation in the archipelago. We are also requesting permission to collect near-shore and open ocean water samples for water quality analysis of various parameters including dissolved inorganic carbon (DIC), nutrients and chlorophyll.

Objectives

- 1) Perform conductivity, temperature and depth recorder (CTD) casts to gather continuous profiles of temperature and salinity against depth in shallow water environments and at REA sites.
- 2) Conduct DIC, nutrient sampling and chlorophyll sampling in conjunction with a subsection of the CTD casts at REA sites, to establish the values that are an effective measure of trophic status, phytoplankton community health, and can be used as a measure of water quality.
- 3) Complete maintenance, replacement and installation of various oceanographic instrument arrays and acoustic monitoring devices that are conceived to be long-term scientific features at consistent sites.

7. Answer the Findings below by providing information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Monument:

The Findings are as follows:

a. How can the activity be conducted with adequate safeguards for the cultural, natural and historic resources and ecological integrity of the Monument?

The Coral Reef Ecosystem team members conduct monitoring reef surveys with little to no adverse impacts to the natural resources of the Monument. The scientific objectives are to observe the natural habitat with minimal disturbance and to only come in contact with resources

in limited occurrences to further comprehensive understanding and research in the Monument. In addition, team members attend a Hawaiian Cultural Briefing each year before entering the Monument waters. This education instills the awareness of the natural, cultural and historical values the Monument holds. Also, the NOAA research ship HI'IALAKAI has informative cultural literature provided by the Office of Hawaiian Affairs (OHA) and the Monument for personnel seeking further knowledge or who may not be able to attend the briefings.

b. How will the activity be conducted in a manner compatible with the management direction of this proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument cultural, natural and historic resources, qualities, and ecological integrity, any indirect, secondary, or cumulative effects of the activity, and the duration of such effects? All management regulations pertaining to the Monument are strictly adhered to when conducting operations within the Monument (such as disease mitigation regulations) and in Special Preservation Areas. The PIFSC and CRED supplies trained, knowledgeable and experienced researchers who are aware and educated of the Monument's cultural, natural and historic resources, qualities and ecological integrity through cultural educators; partnerships with the co trustees; and act accordingly to enhance the management of the Monument. To the knowledge of PIFSC and CRED, there are to be no indirect, secondary, or cumulative effects on the Monument's cultural, natural and historic resources, qualities and ecological integrity from the proposed activities. All activities proposed provide critical data that will greatly enhance the Monument managers' ability to characterize and understand the ecosystems within the Monument. As stated, all scientific methods to be used on this cruise are designed to have minimal, if any, negative effects on the environment or cultural resources. There are no anticipated indirect, secondary or cumulative effects of the proposed methods. The uniformed goals of conservation and management are of utmost importance to the intended research and no work outside of permitted activities shall be considered.

c. Is there a practicable alternative to conducting the activity within the Monument? If not, explain why your activities must be conducted in the Monument.
There is no practicable alternative to conducting the research within the Monument because monitoring data gathered from this research pertains to the area being managed and is to be utilized by the Monument.

d. How does the end value of the activity outweigh its adverse impacts on Monument cultural, natural and historic resources, qualities, and ecological integrity?
There are to be no adverse impacts on the Monument cultural, natural and historic resources, qualities and ecological integrity from the proposed activities. All intended activities contribute significantly to an understanding of the ecosystems within the Monument. CRED intends to provide the scientific data needed to support management of the Monument through cruise reports and coral reef ecosystem monitoring reports.

e. Explain how the duration of the activity is no longer than necessary to achieve its stated purpose.
The NWHI RAMP cruise will use the minimum amount of time needed within Monument waters to complete the required work. Due to the considerable size of the Monument and the transit time

between locations, the provided schedule will maximize the amount of operational days available.

f. Provide information demonstrating that you are qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.

Personnel from NOAA Pacific Islands Fisheries Science Center's Coral Reef Ecosystem Division have collected monitoring data with no adverse impacts to the natural resources of the Monument and in other U.S. related Pacific Islands. RAMP cruises have been successfully conducted on an annual basis in the NWHI since 2000 in conjunction with the co-trustees of the Monument. Team members are experienced divers and highly trained personnel who will be under the guidance of the Chief Scientist (CV attached).

g. Provide information demonstrating that you have adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct. RAMP operations are funded by yearly grants from the NOAA Coral Reef Conservation Program to the Coral Reef Ecosystem Division, which is a part of the NOAA Pacific Islands Fisheries Science Center. NOAA's Pacific Islands Fisheries Science Center contributes in kind to the foundation and activities conducted by the CRED. Collaborators and partners also supply personnel and effort through their own funding.

h. Explain how your methods and procedures are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument cultural, natural and historic resources, qualities, and ecological integrity.

Standardized survey procedures are employed during operations. A Dive Plan has been formulated and all NOAA diving procedures will be followed. For each discipline there are procedure manuals, including safety instructions, for both ship and diving operation that are followed and enforced. RAMP cruises are conducted with the intention of monitoring and assessing the coral reef ecosystem with as little impact as possible to the Monument resources. Through various cruises and reports the methods used have shown to have little impact on the habitat being observed.

i. Has your vessel been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of Presidential Proclamation 8031?

Under a separate permit, the Hi'ialakai is outfitted with a mobile transceiver unit.

j. Demonstrate that there are no other factors that would make the issuance of a permit for the activity inappropriate.

We are not aware of any other factors that would make the issuance of a permit for the activity inappropriate. CRED plans to conduct the vigilant operations and concise protocols exhibited on previous RAMP cruises unless requested by the Monument to modify.

8. Procedures/Methods:

All diving and boating activities are conducted in accordance with NOAA policies and safety regulations.

The proposed research would be conducted from August 27th, 2010 to September 30th, 2010 using the NOAA research vessel *Hi'ialakai* as a platform.

In order to properly manage the coral reefs and related waters of PMNM, Pacific RAMP cruises utilize several disciplines to monitor the various biota and environments. The primary research areas are listed below with accompanying descriptions (Algae 1; Coral and Coral Disease 2; Invertebrates 3; Fish 4; and Oceanographic & Water Sampling 5):

Benthic Field survey Techniques

At each survey site, two to three 25 m transect transects are the focal point for the coral surveys.

1.) Algae

Working at depths of 3 to 16 m with teams using other existing rapid assessment methods, a point-intercept method for algal assessment has been created that minimizes the time in the water yet yields the greatest amount of data possible. Additionally, a high-resolution digital camera mounted on a 0.18 m² photo-quadrat frame will be used to quantitatively assess benthic marine substrates to create permanent historical records of each site.

- Line Point Intercept (LPI): A single diver swims over the lines and assess the benthic elements falling at fixed 20 cm intervals along each transect line. Each such element is tallied and recorded under the following scheme: live coral, recent dead coral, carbonate pavement, coral rubble, sand, rock, turf-algae, macro-algae, invertebrate, and other. Live benthic elements including coral, algae, and invertebrates were identified to the lowest taxonomic level possible. This data is used to provide the basis for quantitative estimates of live coral cover, as well as percent cover of the diverse benthic and substrate components. Algal species inventories and percent cover will be generated from data collected at each site. After the LPI is complete, phycologists conduct a qualitative assessment of algal species growing within 5-m on either side of the transect line, and document additional algal species not recorded during the LPI assessment. A voucher specimen of each algal species is collected and to confirm in situ taxonomic identifications.
- Phycologists collecting data using the point-intercept method will record the macroalgal species, algal functional group, invertebrate functional group, or substrate type at 20-cm intervals along two 25-m transect lines on a sheet of waterproof paper. Algal species inventories and percent cover will be generated from data collected at each site. After the LPI is complete, phycologists conduct a qualitative assessment of algal species growing within 5-m on either side of the transect line, and document additional algal species not recorded during the LPI assessment. A voucher specimen of each algal species is collected and to confirm in situ taxonomic identifications.
- Phycologists collecting data using the photo-quadrat method will record relative abundance of macroalgae in each quadrat on a waterproof data sheet that includes space for recording the species found in the quadrat, a "map" area for identifying cryptic species in depressions that may prove difficult in computer analysis, and codes for the most common genera and species of macroalgae, corals, invertebrates, and substrate types to standardize and shorten note taking. Two trained observers move along the transect together with one observer placing the framer and operating the camera and the other taking notes. Photographs are taken at predetermined random points. After a photograph is taken by the first diver, the second diver identifies algae within the photo-quadrat, records the relative abundance of the 5 most abundant algae on a scale of 1 - 10 (with 1 being most abundant), draws a quadrat map locating species that may be hard to identify in a photograph, and collects representative samples of the algal species in the quadrats for later identification in the laboratory. Once data are recorded, the photo-quadrat is moved to the next random point and the procedure repeated. To prevent redundancy and minimize impact to the environment, only samples of new algal species found in subsequent quadrats are collected. A random swim at the end of the dive is used to collect specimens not present within photo-quadrats.

• *Halimeda*/ocean acidification collections. Species of the green algal genus *Halimeda* are among the most important producers of calcified sediments in reef systems. As the acidity of our

oceans increases, calcification rates and the ability of *Halimeda* to produce sediments may fall precipitously. In order to gain baseline understanding of calcification levels in *Halimeda*, a joint project between CRED and Scripps Institution of Oceanography is sampling *Halimeda* populations across the Pacific to determine ambient levels of CaCO_3 among different species from different geographic areas. In order to accomplish this, 8 individuals of *Halimeda velasquezii*, *H. discoidea*, and *H. opuntia* will be collected haphazardly by hand from each established REA site visited in the NWHI (when present). Specimens will be frozen after collection, and shipped to Scripps for analysis of percent calcification.

- Plankton tows will be conducted using a bongo net (200um mesh size). Per each island or atoll, two 15 minute surface tows will be done near REA sites where water for microbiological sampling is also collected. One tow will sample the reef water directly above the REA site, and a second will be performed ~0.5km directly offshore. Plankton will be removed from the net by rinsing detachable cod ends with sterile seawater. Samples will be immediately fixed using 95% ETOH (ethyl alcohol) and stored at 4 degrees C in a 50ml conical until they can be processed at SDSU.
- Additional Collections: Up to ten additional samples (approximately 400 ml wet volume) of macroalgae will be collected in whirl-packs at REA sites where water for microbiological sampling is also collected. Samples will represent the most dominant algal-types. At the same sites, ten small samples of coral rubble (maximum 10/site, ~5-10 cm each) will also be collected in whirl-packs. Samples will only be collected by the benthic team members if time permits. All samples will be stored at -20 degrees C until they can be transported to SDSU for analysis. 16S cloning and sequencing will be performed to characterize the microbial communities associated with benthos. Community shifts in the microbes associated with the benthos (rubble and algae) should be a useful indicator of reef health.

2.) Coral and Coral Disease:

Coral community structure and coral disease: Within each of the two transects above, five, 2.5-meter segments are surveyed (beginning at points: 0, 5, 10, 15, and 20 meters), whereby in each segment, all coral colonies whose center falls within 0.5 meters of either side of the transect line are identified to the species level and two planar size metrics collected (i.e., maximum diameter and maximum diameter perpendicular to the maximum diameter). The extent of colony mortality, both recent and old, is also estimated for each colony; special attention is paid to identifying as best as possible the extent of the former live colony. In addition, cases of disease or compromised health are recoded and additional information collected, including type of affliction (bleaching, skeletal growth anomaly, white syndrome, subacute tissue loss, band diseases, necroses, pigmentation responses, algal and fungal infections, as well as other diseases of unknown etiology, and predation), severity of the affliction (mild, moderate, marked, severe, acute), as well as photographic documentation and sometimes tissue samples. Coral tissue samples were catalogued and fixed in buffered zinc-formalin solution for further histopathological analyses.

Benthic tow board surveys: Shallow water habitats around each island, bank, or reef are surveyed using pairs of divers towed 60 meters behind a 19' SAFE Boat survey launch. In each towed-diver buddy team, one diver is tasked with quantifying the benthos while the other quantifies fish populations. Each towed-diver survey lasts 50 minutes, broken into 10 five minute segments, and covers approximately 2 km. A GPS track of the survey launch track is recorded at five-second intervals using a Garmin GPS76Map GPS unit. A custom algorithm is used to calculate the track of the divers based on the track, speed, and course of the boat and depth of the diver. Each tow board is equipped with a precision temperature and depth recorder (Seabird SBE39) recording at five second intervals. At the end of each day data are downloaded, processed and presented in Arc GIS and can be displayed in conjunction with IKONOS satellite imagery, NOAA chart data and/or other spatial data layers. The benthic tow board is equipped with a downward high resolution digital still camera with dual strobes. The downward-looking camera is maintained 1-2 m off the bottom and is programmed to photograph benthic substrate every 15 seconds. The diver on the benthic tow board observes and records habitat

composition (hard coral, stressed hard, soft coral, macro algae, coralline algae, sand and rubble) and tallies conspicuous macro invertebrates (crown-of-thorns starfish (COTS)), urchins, sea cucumbers, and giant clams) along a 10-m swath.

Specimen collection: Because a particular type of gross lesion can present multiple microscopic manifestations, coral assessments and studies require biopsies or samples for histological (microscopic) evaluation and verification. We also have an interest in conducting studies investigating the potential molecular responses that may be associated with the disease condition. Hence, we are requesting the permit to cover the collection of a maximum of 20 samples representing each species/taxon and seven general disease gross morphologies including: tissue loss, tissue necrosis, and pigmentation responses, including discolorations and fungal infections (Vargas-Angel 2009; see table below). Procured coral tissue samples will not be more than 7 cm maximum diameter; this is to allow sufficient diseased and healthy tissue within each sample. Additionally, we would like to conduct opportunistic sampling of any potential new diseases observed at the sites visited, if any do appear to occur. No more than 2 type samples (healthy and disease) will be collected for each suspected new disease state. In no case will specimens be collected if it is judged that doing so might inhibit the capacity of the taxon to replenish itself. In the field, coral tissue samples (no more than 7 cm maximum diameter) will be carefully collected using cutting pliers or hammer and chisel. Samples will be placed in labeled specimen bags containing seawater and stored in a dark container.

Aboard the ship, coral tissue samples will be fixed in zinc-formalin (Z-fix® Anatech Ltd) for 18–24 hours and subsequently transferred to 70% ethanol. Samples for RNA molecular studies will be fixed in Trizol and subsequently placed in deep refrigeration (–40°C). Waste product (i.e., formaldehyde fixing solution) will be stored for appropriate chemical disposal in Honolulu. Aboard the ship, coral tissue samples will be fixed in zinc-formalin (Z-fix® Anatech Ltd) for 18–24 hours and subsequently transferred to 70% ethanol. Samples will be stored in 70% ethanol in capped containers and transported to Honolulu. Waste product (i.e., formaldehyde fixing solution) will be stored for appropriate chemical disposal in Honolulu. In collaboration with scientists Alison Moulding and Abby Renegar at Nova Southeastern University, Dania Beach Florida, histopathological sample processing will be conducted. Tissue samples and paraffin blocks will be accessioned at an appropriate institution (e.g., Bishop Museum, Honolulu). Additionally, in collaboration with scientists Michael Morgan and Sara Edge at Berry College, Georgia, and Harbor Branch, FL, respectively, RNA studies will be conducted on selected samples aimed at investigating the molecular responses that may be associated with the disease condition.

Coral Coring: Coring of massive coral colonies to determine historical coral growth and accretion rates to provide paleoceanographic time series of calcification and growth rates to hindcast the carbonate chemistry climate of coral reefs from hundreds of years past. To quantify the size and density of annual growth bands in coral skeletons, core samples would be collected and preserved for analysis by nondestructive CAT scan and image analysis techniques to visualize growth bands that cannot otherwise be observed.

Only a few cores at an island are necessary, and, thus, the number of colonies sampled is low. A minimum of three cores and maximum of five cores are collected within a close proximity (3–5m) to each other, at each REA location. Two REA sites are intended to be chosen for coring at each island or atoll, yet this will be dependant on ocean conditions. A maximum of 21 coral cores are proposed with a minimum target of 18 coral cores requested. The relatively common species found throughout the Pacific, *Porites* spp. are the target for coral core sampling. These species are typically stable and successful and not currently in danger or threatened. The 2–3 person dive team will locate an adequate coral colony and then use a pneumatic drill with a masonry core drill bit powered by a SCUBA tank. A core will then be collected from a single colony of sufficient size and health such that extracting a very small core, 2.5 cm in width and 5–40 cm in length, is judged not to be destructive or detrimental to the longevity of a colony. The core is then placed in a specific storage container for that sample where it remains and is stored aboard the ship until returning to Honolulu. Through analyses of data from current CREO monitoring efforts, the abundance of colonies meeting the criteria is established at each island and

cores are only taken when and where there will be little impact. Upon completion of a coring, a cement plug is affixed to seal the hole, preventing invasion of a colony by bioeroding species. A cement plug provides a suitable surface over which surrounding coral tissue can grow. In 2 years, scars are typically completely healed and plugs are no longer visible. Corals of the genus *Porites*, *Pavona* and *Diploastrea* may be targeted.

Summary table enumerating the types of corals and numbers of samples to collected for coral health disease assessment and characterization studies during PIFSC-CRED 2010 NOWRAMP cruise

Gross morphology	Coral affected	Number and size
Tissue loss	<i>Porites lobata</i>	20, 7cm
	<i>Porites evermanni</i>	10, 7cm
	<i>Porites compressa</i>	10, 7cm
	<i>Pocillopora eydouxi</i>	10, 7cm
	<i>Montipora</i>	10, 7cm
	<i>Pocillopora meandrina</i>	10, 7cm
Tissue necrosis	<i>Porites lobata</i>	10, 7cm
	<i>Porites evermani</i>	10, 7cm
Tissue pigmentation response	<i>Acropora cytherea</i>	10, 7cm
	<i>Porites lobata</i>	10, 7cm
	<i>Porites evermani</i>	10, 7cm
	<i>Porites compressa</i>	10, 7cm
Subtotal		130 samples
Coral Coring	Assorted Genera.	18, 20 cm
Total		148 samples

Additional permitting is requested to accommodate the collection of voucher specimens of a maximum total of 75 Pacific scleractinian species (see Appendix I, attached) that have been petitioned by the Center for Biological Diversity to be listed under the Endangered Species Act (ESA). According to the lobbyist the petitioned species occur within the US Pacific and have suffered population declines of >30% due to numerous threats, including habitat deterioration, pollution, sedimentation, recurrent bleaching, resource overexploitation, and disease outbreaks. Additional impacts from impending global warming and ocean acidification are expected threat the above-mentioned species with extinction before mid-century. Collections will be conducted based on provisional identification of specimens in the field. Voucher samples will be used for taxonomic verification and documentation, as well as for museum archival purposes. Voucher samples will be no more than 7 cm maximum diameter. Each specimen will be carefully collected using a hammer and cold chisel, and placed in labeled bags together with site and depth location. No more than 2 specimens will be collected for each species per site; one sample will be bleached to remove tissue and stored dry. The second sample will be fixed and preserved in 95% ethanol to enable potential future molecular taxonomic verification if needed. In no case will specimens be collected if it is judged that doing so might inhibit the capacity of the taxon to replenish itself.

We are also requesting permit to cover the collection of coral samples for taxonomic verification. Collections will be based upon provisional identification of candidate new records or species not yet described in the field. Because high-resolution digital photographs can provide adequate information concerning colony morphology, samples required for taxonomic verification need only be large enough to examine skeletal structure (e.g., polyp structure and coenosteum patterning) with a dissecting microscope; hence samples will be no more than 7 cm maximum diameter. Each specimen will be carefully

collected using a hammer and cold chisel, and placed in labeled bags together with site and depth location. No more than 2 type specimens will be collected for each suspected new coral species and some new records. Samples will be bleached to remove tissue, and stored dry until an appropriate expert is identified and agrees to examine the specimen. In no case will specimens be collected if it is judged that doing so might inhibit the capacity of the taxon to replenish itself.

Permanent Transects: Monitoring relies in large part on the selection of fixed sites and periodic resurvey of such sites. The intention of providing fixed, geo-referenced markers is to enable researchers to return to exact locations on subsequent visits so as to reduce spatial imprecision in deploying transect lines and re-surveying the site. Statistical power in detecting change over time is thus enhanced by increasing spatial precision. For this reason, it is desired to establish permanent transect markers at long-term monitoring sites established during previous cruises. Establishing a permanent transect involves manual installation of durable transect markers at REA sites on hard dead substrate, away from living corals. These transect markers will consist of cable ties (1m) or a combination of cable ties and a 15-20 cm in length plastic float. One marker will be installed at the beginning of each transect. At sites where the bottom offers the appropriate topographic complexity, several (2-5) cable ties will be secured to benthic features to create a loop to which the plastic float be attached. In areas with less porous substrates, a stainless steel shield eye-bolt anchor may be needed to secure the cable ties and plastic float to the substrate. The bond between the eye-bolt anchor and the bottom may need to be secured by adding a dab of underwater epoxy. These transect markers will consist of cable ties (1m) or a combination of cable ties and a stainless steel shield eye-bolt anchors (7-10 cm in length). One marker will be installed at the beginning of each transect. At sites where the bottom offers the appropriate topographic complexity, several (2-5) cable ties will be secured to benthic features to create something that looks unnatural from the surrounding area. In areas with less porous substrates, a stainless steel shield eye-bolt anchor will be secured to a crack in the pavement or rock and from there cable ties will be attached, again, to create something that looks different. The bond between the eye-bolt anchor and the bottom may need to be secured by adding a dab of underwater epoxy. An underwater epoxy applicator is then used to better affix the stake to the substrate. Each stake measures 3 ft height and 3/8th - inch diameter; similar stakes have been used successfully with no signs of corrosion over a 2-year period. All other equipment (hammers, epoxy applicators, transect tapes) will be removed from the reef at the completion of each survey.

3.) Invertebrates: Field survey techniques

Surveys for non-coral marine invertebrates will be done quantitatively along two separate 25 meter transect lines. After the completion of the two transects, a roving swim is conducted associated with the original transects to collect qualitative data for rare and cryptic organisms and to survey any additional habitats present at the site (e.g. sand, sea grass, reef crest). Also at this point, a variety of specialized collections will be taken:

- 1) Additional collections of organisms unable to be identified in situ
- 2) Population size structure data will be collected on urchins
- 3) Collections of targeted species for phylogeography work conducted in the Pacific

Species that cannot be identified in the field will be collected and brought back to the research vessel for further analysis. Organisms that are identified back at the research vessel will be returned to the field the same or next day. Species that cannot be identified or are collected for connectivity research will be preserved in ethanol, formalin or frozen for further analysis at the University of Guam, University of Hawaii, Florida Museum of Natural History, Smithsonian and/or the Bishop Museum.

The analysis at these institutions will involve the use of taxonomic literature to make tentative identifications. Then specimens will be sent to experts throughout the world for confirmation of these identifications. These findings and the field identifications will be given to the appropriate agency representatives sponsoring the expedition to PMNM in the form of a final report and species list. Ultimately, field-collected specimens will be critically analyzed through the process

described above, which supports efforts documenting biodiversity associated with these remote habitats. Subsequently specimens will be made available to researchers throughout the world through access to catalogued collections. The targeted organisms undergoing connectivity studies in the central Pacific will be genetically processed and analyzed at the Hawaiian Institute of Marine Biology. Genetic surveys of connectivity among reef habitats substantially augment the scientific foundation for conservation measures. Population genetics of marine invertebrates will aid in our understanding of population size and migration (dispersal and recruitment) of marine organisms in PMNM and the central Pacific. Collection of the following marine invertebrates will be aiding on-going molecular research on recruitment and connectivity among marine invertebrates throughout the central Pacific being conducted at the Hawaiian Institute for Marine Biology (HIMB) and the University of Hawaii. The table below lists the desired species, the anatomical part needed for molecular analysis and the collection method. Parts will be removed either underwater during the dive then placed within a mesh bag or whirlpak or else organisms will be collected during the dive and parts will be removed on the surface in the dive boat before being returned to the habitat. Since collections are not the emphasis on this cruise and will be occurring fortuitously by REA divers during their surveys, collections will be an on-going process over the next several years.

Table 1: Desired species, anatomical part needed for molecular analysis and collection method

Scientific Name	Part for Analysis	Collection Method
<i>Octopus olivei</i>	tissue	Use tweezers and a knife to snip off a small piece of tentacle
<i>Cellana</i> spp.	piece of foot muscle	Use tweezers to snip a small piece of the muscle
<i>Linckia multifora</i>	arm	Break off a piece of their arm with fingers
<i>Holothuria atra</i>	skin plug	Use knife to cut off piece of skin.
<i>Holothuria whitmaei</i>	skin plug	Use knife to cut off piece of skin.
<i>Panulirus marginatus</i>	leg	Clip 1 cm of the leg with wire cutters at the bottom or top joint
<i>Panulirus penicillatus</i>	leg	Clip 1 cm of the leg with wire cutters at the bottom or top joint
<i>Ophiocoma erinaceus</i>	arm	Detach an arm by holding on to it with tweezers
<i>Ophiocoma pica</i>	arm	Detach an arm by holding on to it with tweezers
<i>Stenopus hispidus</i>	leg or front claw	Remove either a claw or walking leg with tweezers
<i>Colobocentrotus atratus</i>	tube feet or whole	Pluck off tube feet with tweezers
Asterinids	whole	
<i>Hippocampus kuda</i>	whole and tissue	snip off piece of tail
<i>Hippocampus fisheri</i>	whole and tissue	snip off piece of tail

ARMS Installation: Autonomous Reef Monitoring Structures (ARMS) were installed 2 years ago during the 2008 NWHI RAMP cruise in relation to REA sites. ARMS are small, long-term collecting devices designed to mimic the structural complexity of a coral reef. This device attracts colonizing invertebrates over the period during which they are left in the field. Each of the ARMS measures 14 in. by 18 in. by 8 in. and contain nine 9 in. by 9 in. layers for colonization. Layers alternate between open surfaces and semi-closed surfaces containing triangular-shaped caves. The top-most layer is a convoluted filter layer. The ARMS were placed on pavement or sand, in proximity to coral reef structures, specifically to avoid coral damage. The ARMS were deployed by divers using stainless steel stakes and weights to insure that they remain in place for the duration of 1-2 years. Existing ARMS will be replaced with new ARMS by reinstalling the new ones over the old stakes. If stakes are not reusable, new ones will be implemented. A Global Positioning System (GPS) point is taken for each of the ARMS after deployment for accurate relocation. The Coral Reef Ecosystem Division of the Pacific Islands Fisheries Science Center will be responsible for maintaining and removing the installations during a follow-up cruise.

ARMS Retrieval: Removal consists of covering and latching down the ARMS units with a mesh lined crate, bringing them to the surface support vessel, and transferring them to the Hi'ialakai

for processing. On board the Hi'ialakai, the ARMS are disassembled, the plates are photographed for sessile organisms and the water used during the processing is sieved for the motile organisms. Motile organisms are immediately preserved. The plates are soaked in ethanol and eventually scraped clean. The sessile organisms scrapped off the plates is preserved. All organisms that recruited to ARMS units are processed and stored in 95% ethanol. Back on land, the contents will be sent to our partners at the Smithsonian, Florida Museum of Natural History L.A. County Museum, University of Hawaii at Hilo, San Diego State, Moss Landing Marine Laboratories, Scripps Oceanographic Institute, and Hawaiian Institute of Marine Biology who will begin the molecular processing and taxonomic archiving. Genetic sequencing will provide a relative index of diversity for each of our survey sites. The number and types of specimens sent to each of these institutions will vary pending on what recruits to the ARMS platforms.

4.) Fish: Field survey techniques

Two complementary, non-invasive underwater-surveys are used to enumerate the diverse components of diurnally active shallow-water reef fish assemblages. Each method is replicated at sites within and/or among the various habitat types present around each island or bank. For both methods, fish are identified to lowest possible taxa and their size estimated. Resulting data therefore provides information on size structure and provides the basis for estimation of biomass densities by taxa. No permanent markers, e.g. transect pins are used for either of the fish survey methods.

Survey Types:

1) Stationary Point Counts (nSPC). Stationary point counts are the main method used by CRED to survey reef fish assemblages. At each site, replicate nSPC surveys are conducted by a pair of divers, surveying adjacent visually-estimated cylinders of 7.5 m radius, centered on the divers. Each nSPC diver records the number, size (TL, to nearest cm), and species of all fishes present or passing through the cylinder in the course of the survey. nSPC surveys consists of 2 components: (i) a 5 minute species listing component – the aim of which is to build a list of species present or passing through the cylinder; and (ii) an enumeration component, in which each diver records the number and sizes of fishes of those listed species in a series of instantaneous visual sweeps of their cylinder. Where time allows, 2 pairs of nSPC cylinders are surveyed per site per dive. nSPC Survey sites are randomly located with specified habitat strata encompassing all 0-30m hardbottom areas at each surveyed reef -with specific position generated prior to each cruise using a randomization tool and CRED's GIS habitat and bathymetric layers. As described above, survey locations are re-randomized each time, hence no permanent site markers are needed.

2) Towed-diver Survey: Shallow water habitats around each island, bank, or reef are surveyed using pairs of divers towed 60 meters behind a 19' SAFE Boat survey launch. In each towed-diver buddy team, one diver is tasked with quantifying the benthos while the other quantifies fish populations. Each towed-diver survey lasts 50 minutes, divided into 10 five minute segments, and covers approximately 2 km. A GPS track of the survey launch track is recorded at five-second intervals using a Garmin GPS76Map GPS unit. A custom algorithm is used to calculate the track of the divers based on the track, speed, and course of the boat and depth of the diver. Each tow board is equipped with a precision temperature and depth recorder (Seabird SBE39) recording at five second intervals. At the end of each day data are downloaded, processed and presented in Arc GIS and can be displayed in conjunction with IKONOS satellite imagery, NOAA chart data and/or other spatial data layers. The fish tow board is equipped with a forward-looking digital video camera which creates an archive of the survey track and can be used to evaluate stochastic changes in the reef environment, particularly following episodic events such as coral bleaching and vessel grounding. The diver on the fish tow board records (to the lowest possible taxon) all fishes greater than 50 cm total length (TL) along a 10-m swath in each time segment. The species and length to nearest 5m are recorded for each observation.. Fish species of particular concern,

and all turtles, observed outside the survey swath are also recorded. Those are classified as presence/absence data and are analyzed separately from the data from the 10m swathes. Specimen collection
No collections of fish specimens are planned, at present. However, permission is requested to collect several specimens of fish, on occasion, if considered to be a new record or new species of fish, or other notable significance.

5.) Oceanography: Techniques

The seafloor instruments are 'temporary' in that they can be deployed and completely removed, if necessary. Sites with instruments are conceived to be a long-term data collection sites. We plan to swap out moored instruments every two-three years and maintain them when needed with the sites remaining consistent from year to year. The retrieval and replacement of installed equipment in the future is intended to be conducted on subsequent cruises. Anchors (aka moorings) are replaced on a similar 2-3 year schedule. 'Servicing' (replacement or retrieval) of an instrument and/or anchor takes place by CREO primarily but with occasional assistance from partners on other research cruises (Carl Meyer, Whitlow Au, USCG Marine Debris, PIFSC Marine Debris, etc.) to replace instruments.

- Acoustic Doppler Current Profilers (ADCP) and Wave and Tide Recorders (WTR) collect information on water velocity, water level, and waves. These are typically a cylindrical body approximately 10 cm in diameter and 80 cm in length. The instrument is typically deployed in conjunction with a ~250 lb anchor weight. ADCP Deployments involve lowering an instrument(s) attached to a weight. A lift bag is used in this procedure.
- Ocean Data Platforms (ODP) are placed on the seafloor and provide high resolution, current profiles, directional wave spectra and temperature and salinity data. A 1200 lb concrete anchor, approximately 1.2 x 1 m, serves as the base. An instrument package sits on top of the base and lift bags are used for both anchors and instrument arrays.
- Ecological Acoustic Recorder (EAR) units: The EAR is a digital, low power system that records ambient sounds at frequencies up to 30 kHz on a programmable schedule. EAR consist of a cylindrical body approximately 10 cm in diameter and 80 cm in length. The instrument is typically deployed in conjunction with a ~250 lb anchor weight. They collect information on ocean sounds (natural and anthropogenic) EAR units are attached to weights and deployed on the seafloor. A lift bag is used in this procedure.
- Sub-surface temperature recorders (STR) are used to construct a time series of water temperature data at various locations on a reef. These small instruments are placed on the sea floor and in coral reefs and provide high resolution data sets of ocean temperature. STRs are cylindrical bodies approximately 5 cm in diameter and 25 cm in length. Two cylinders are typically strapped together, one is the instrument, and the other is a weight.
- Sub-surface salinity recorders measure water conductivity and temperature, from which salinity values can be derived. These cylindrical instruments are approximately 10 cm in diameter and 75 cm in length and are typically attached to a weight and placed on the seafloor
- Sea Surface Temperature (SST) Buoys float on the sea surface and are moored to a weight. The instrument provides high resolution SST which is transmitted to the Pacific Islands Fisheries Science Center via satellite. SST are a 0.5 m diameter buoy attached to a floating mooring line preventing contact with the sea floor and secured to a 250lb anchor weight which is deployed with a lift bag onto a sand substrate.
- Ion Sensitive Field Effect Transistor (ISFET) pH sensors provide a valuable tool for studying CO₂ dynamics in coral reef ecosystems and investigating the impacts of ocean acidification. ISFET are a cylindrical body approximately 10 cm in diameter and 80 cm in length. The instrument is typically deployed in conjunction with a ~250 lb anchor weight or fastened to the sea floor with removable fasteners.
- Calcification Acidification Units (CAUs) are used to monitor calcification rates across reefs and islands experiencing different physical oceanography and local human impacts. CAUs study the in situ ecological impacts of ocean acidification by measuring variations in the calcification rates of stony corals and crustose coralline algae. A CAU is a small device and

is typically deployed in a set of five at a REA site. The device consists of a pair of 10cm x 10cm poly vinyl chloride plates that are attached to the reef with permanent stainless steel transect markers and underwater epoxy.

- Conductivity-Temperature-Depth (CTD) casts are used to collect information about the vertical salinity and temperature structure of the water column. An instrument array is lowered and retrieved above the sea floor by hand and line from a small boat or carried by a diver dependant upon the site and depth.

- Oceanographic Water Sampling: Niskin bottles are used by divers to collect water samples. Typically two samples are collected at each REA site, one just above the benthos, and one near the surface. Four Niskin bottles, four messengers, and the ~35m deployment rope may also be used to take grab samples at depth from a small boat. The standard sampling depths are 1, 10, 20, and 30 meters and the seawater collected within each Niskin bottles are sub-sampled to collect water in uniquely labeled bottles for post cruise nutrient, Chlorophyll, and dissolved inorganic carbon (DIC) analyses. A solution of mercuric chloride will be used to halt biological activity in the water samples which will be analyzed for DIC. Samples will also be collected with Remote Auto Sampler (RAS) units that automatically collect water samples, at pre-programmed intervals, over a period of a day, week, month, or longer. Collecting water samples autonomously while deployed, the RAS allows for the investigation of the diel variability of carbonate chemistry on the reef. The RAS will be deployed for 2-3 day periods at select locations. Water samples are stored on-board the instrument in specialized bottles and bags which are collected after recovery of the instrument. Lift bags will be used to deploy and recover the RAS. Anchors weights will be used to hold the instrument in place.
- Microbiological Water Sampling: Diver-deployable Niskin bottles will be used to collect 20 liters of seawater (4 bottles; 2 liters per bottle) at each REA site. All samples will be collected .5-1 meters above the reef surface at a depth of ~10 meters and transported back to the ship.

1) Microscopy:

a) One ml of water from each sample will be fixed with paraformaldehyde and filtered onto nucleopore filters (0.02 and 0.2um). Filters will be stained with SYBR-Gold (for counting microbes and viruses) and DAPI (for obtaining cell size measurements)

b) Slides will be stored in a slide box at -20 degrees C until they can be transported to San Diego State University for processing.

2) Water chemistry:

Water samples will be pushed through GF/F glass filters and the filtrate will be collected in glass bottles. Hydrochloric acid (30ul) will be added to each bottle (to remove dissolved inorganic carbon) and the bottles will be stored at 4 degrees C. These samples will be analyzed for dissolved organic carbon at SDSU. The GF/F filters will be stored at -20 degrees C and analyzed for particulate organic carbon (concentration and stable isotopes of C & N) at SDSU.

3) Archive microbial DNA samples:

The rest of the water in each Niskin bottle will be pushed through a 20um profiler followed by a 0.2 micron Sterivex filter. The filter will be stored at -20 degrees C until the DNA can be isolated for 454 sequencing at SDSU.

4) Flow cytometry:

5ml of water from each site will also be pushed through a 20um filter. The filtrate will be dispensed into 3 x 5 ml cryovials, and glutaraldehyde added to each [final = .125%]. Vials will be inverted to mix, and incubated in the dark for 15 min. The glutaraldehyde preserved samples will be flash frozen in liquid nitrogen (contained in a dry shipper) until they can be transported to SDSU for flow cytometry analysis.

NOTE: If land or marine archeological activities are involved, contact the Monument Permit Coordinator at the address on the general application form before proceeding, as a customized application will be needed. For more information, contact the Monument office on the first page of this application.

9a. Collection of specimens - collecting activities (would apply to any activity): organisms or objects (List of species, if applicable, attach additional sheets if necessary):

Common name:

1.) The goal of algal surveys is to quantitatively describe the algal community and prepare a comprehensive species list for each site. For macroalgae: one specimen of each species that cannot be identified in the field will be collected. This will not amount to more than one 4"x 6" ziploc sample bag of material. If samples can be identified in the field, no samples will be collected. For *Halimeda*/ocean acidification collections: 8 individuals of *Halimeda velasquezii*, *H. discoidea*, and *H. opuntia* will be collected haphazardly by hand from each established REA site visited in the NWHI (when present). For microbial rubble surveys, a maximum of 10 pieces of rubble/site, with each piece being no larger than 5-10 cm, may be collected

2.) The target corals are giant table coral, rice coral, lobe coral, cauliflower coral and antler coral. In no case will specimens be collected if it is judged that doing so might inhibit the capacity of the taxon to replenish itself.

3.) For non-coral invertebrates collected the analysis will occur at Bishop Museum, CRED, and/or HIMB and will involve the use of taxonomic literature to make tentative identifications and then specimens will be sent to experts throughout the world for confirmation of these identifications. These findings and the field identifications will be given to the appropriate agency representatives sponsoring the expedition in the form of a final report and species list. This is a lengthy process (1-2 years), and is dependent on funding and resources for this post-expedition processing.

Specimens to be collected will be from the following taxonomic groups:

- Sponges
- Anemones and Hydroids
- Marine worms
- Snails
- Sea slugs
- Mussels and clams (exception: black-lipped pearl oysters)
- Octopus and squid (only unidentifiable sp)
- Barnacles, decapods, pericarids (exception: spiny lobster and slipper lobster)
- Starfish
- Sea cucumbers
- Brittle stars
- Feather stars
- Moss animals
- Sea squirts

Collection of the marine invertebrates will be aiding on-going molecular research on recruitment and connectivity among corals and other marine invertebrates throughout the Main and Northwestern Hawaiian Islands being conducted at the Hawaiian Institute for Marine Biology (HIMB) and the University of Hawaii. The table lists the desired species, the anatomical part needed for molecular analysis and the collection method. Parts will be removed either underwater during the dive or placed within a mesh bag and/or whirlpak or else organisms will be collected during the dive and parts will be removed on the surface in the dive boat before being returned to the habitat.

4.) Fish Collections: No collections of fish specimens on these cruises are planned, at present.

5.) All plants, algae, and cyanobacteria which photosynthesize contain the pigment chlorophyll-a. Chlorophyll-a concentration is often used as a proxy for phytoplankton abundance and biomass in natural waters. In contrast, pheopigment concentration is used as a proxy for in-situ chlorophyll-a degradation. Thus, the pheopigment:chl-a ratio can be used to represent the amount of phytoplankton cell death and/or grazing of cells, relative to phytoplankton chlorophyll-a present in the water sample. Additionally, these values can be an effective measure of trophic status, phytoplankton community health, and can be used as a measure of water quality. CRED reports chlorophyll-a and pheopigment concentrations in micrograms/liter (µg/L).

Scientific name:

1.) Several hundred species of native marine macroalgae occur in the Northwestern Hawaiian Islands. None of them are listed as endangered. Many algal species are extremely small, requiring the aid of a microscope for adequate viewing. Several hundred species can occur in a 10 cm² area. Any of these species might be collected during surveys.

2.) The target coral taxa are: *Acropora*, *Porites*, *Montipora* and *Pocillopora*.

- *Acropora cytherea*
- *Montipora*
- *Porites compressa*
- *Porites lobata*
- *Porites evermanni*
- *Pocillopora eydouxi*
- *Pocillopora meandrina*

3.) Specimens to be collected will be from the following taxonomic groups:

Phylum Porifera

Phylum Cnidaria

Phylum Annelida

Phylum Mollusca

- Gastropoda
- Opisthobranchia
- Bivalvia (exception: *Pinctada margaritifera*)
- Cephalopoda

Phylum Arthropoda

- Crustacea

Phylum Echinodermata

- Asteroidea
- Holothuroidea
- Ophiuroidea
- Crinoidea

Phylum Bryozoa

Phylum Chordata

- Urochordata

4.) N/A

5.) N/A

& size of specimens:

1.) For macroalgae: one specimen of each species that cannot be identified in the field will be collected. This will not amount to more than one 4"x 6" ziploc sample bag of material.

2 (a.) Disease Because a particular type of gross lesion can present multiple microscopic manifestations, coral assessments and studies require biopsies or samples for histological (microscopic) evaluation and verification. Hence, we are requesting the permit to cover the collection of a maximum of 10 samples representing each species and 3 general gross morphologies including: tissue loss, tissue necrosis, and tissue pigmentation responses. Additionally, we would like to conduct opportunistic sampling of any potential new diseases observed at the sites visited, if any do appear to occur. No more than 2 type samples (healthy and disease) will be collected for each suspected new disease state. In no case will specimens be collected if it is judged that doing so might inhibit the capacity of the taxon to replenish itself.

Summary table enumerating the types of corals and numbers of samples to collected for coral health disease assessment and characterization studies during PIFSC-CRED 2010 NOWRAMP cruise

Gross morphology	Coral affected	Number and size
Tissue loss	Porites lobata	20, 7cm
	Porites evermanni	10, 7cm
	Porites compressa	10, 7cm
	Pocillopora eydouxi	10, 7cm
	Montipora	10, 7cm
	Pocillopora meandrina	10, 7cm
Tissue necrosis	Porites lobata	10, 7cm
	Porites evermani	10, 7cm
Tissue pigmentation response	Acropora cytherea	10, 7cm
	Porites lobata	10, 7cm
	Porites evermani	10, 7cm
	Porites compressa	10, 7cm
Subtotal		130 samples
Coral Coring	Assorted Genera,	18, 20 cm

Total 148 samples

2 (b.) Taxonomic Records: Collections will be based upon provisional identification of candidate new records or undescribed species in the field. Because high-resolution digital photographs can only provide adequate information concerning colony morphology, samples required for taxonomic verification need only be large enough to examine the skeletal architecture (e.g., polyp structure and coenosteum patterning) with a dissecting microscope; hence samples will be no more than 7 cm maximum diameter. Each specimen will be carefully collected using a hammer and cold chisel, and placed in labeled bags together with site and depth location. No more than 2 type specimens will be collected for each suspected new coral

species and some new records. Samples will be bleached to remove tissue, and stored dry until an appropriate expert is identified and agrees to examine the specimen. In no case will specimens be collected if it is judged that doing so might inhibit the capacity of the taxon to replenish itself.

3.) N/A

4.) N/A

5.) Water samples are collected throughout the cruise in conjunction with CTD casts but at separate variables. The amounts of samples are 125mL per chlorophyll sample and 60mL per nutrient sample. Four samples are taken at selected sites for each sampling procedure with periodic double sampling for truth testing. The total number of samples is variable and dependant upon work conditions, specifically conducting additional sampling in regards to tidal changes, weather and unpredicted oceanographic occurrences.

The maximum amount of water sample collections to be conducted are as follows:

FFS = 107 REA Sites

GAR = 3 REA Sites

KUR = 39 REA Sites

LAY = 17 REA Sites

LIS = 38 REA Sites

MAR = 46 REA Sites

MID = 24 REA Sites

NEK = 5 REA Sites

NIH = 2 REA Sites

PHR = 115 REA Sites

Total REA Sites 396 x 2 samples (1 at surface and 1 at depth) = 792 samples

From Shipboard CTD water sampling, ~ 300 samples are intended from various permanent locations as described in the Conservation and Management permit.

Approximately 200 samples for DIC and 50 samples for microbiological analysis at presently unknown locations are also intended to be taken. The location of all samples will be submitted in the cruise completion summary and the cruise report.

A maximum of 1342 water samples are to be taken.

Collection location:

Generally, all specimens collected will occur at or near the REA site locations. These exact positions will be provided in our compliance letter. If an opportunistic collection were to occur outside of these areas, the position will be noted and submitted within the cruise report.

☒ Whole Organism ☒ Partial Organism

9b. What will be done with the specimens after the project has ended?

1.) Ultimately, field-collected algal specimens will be critically analyzed in the laboratory to ensure positive species identification, will be catalogued, and will subsequently be placed in research institutions (primarily the Bishop Museum) where they can be accessed by researchers interested in a suite of topics. After identification, provisions need to be made to ensure appropriate preservation and curation of each algal specimen, providing a historical record that will be available to future researchers. Specimens of *Halimeda* for ocean acidification research will be shipped to Scripps Institution of Oceanography in San Diego for analysis. The specimens will be destroyed during the process that allows for percent CaCO_3 determination. Rubble samples collected for microbial analysis: 16S cloning and sequencing will be performed to characterize the microbial communities associated with the benthos (i.e. rubble and algae). Community shifts in the microbes associated with the benthos should be a useful indicator of reef health or disturbance.

2.) Subsequent preparation of coral tissue samples will take place in Honolulu for histological processing post cruise. In collaboration with scientists Alison Moulding and Abby Renegar at Nova Southeastern University, histopathological sample processing will be conducted. Additionally, in collaboration with scientists Michael Morgan and Sara Edge at Berry College, Georgia, and Harbor Branch, FL, respectively, RNA studies will be conducted on selected samples aimed at investigating the molecular responses that may be associated with the disease condition. After microscopic analyses, paraffin blocks will be accessioned at in an appropriate institution (e.g., Bishop Museum, Honolulu). The list of institutions and samples foreseen to transfer samples for histological preparation and molecular analyses are as follows:

Institution	Point of Contact	Analysis	Taxon	Quantity
Nova SE University	Alison Moulding	Histo-prep	<i>Porites lobata</i>	20
			<i>Porties evermanni</i>	10
			<i>Pocillopora eydouxi</i>	10
			<i>Montipora spp</i>	10
			<i>Pocillopora meandrina</i>	10
			<i>Porites compressa</i>	10
			<i>Porites spp</i>	
Berry Collegue	Michael Morgan	RNA		30
Harbor Branch	Sara Edge	RNA	<i>Montipora</i>	10
			<i>Acropora cytherea</i>	10
			<i>Porites lobata</i>	10
Total				130

3.) Collections for biodiversity assessments from the ARMS will be sent to the Smithsonian, Florida Museum of Natural History L.A. County Museum, University of Hawaii at Hilo, San Diego State, Moss Landing Marine Laboratories, Scripps Oceanographic Institute, and Hawaiian Institute of Marine Biology. The number and types of specimens sent to each of these institutions will vary pending on what recruits to the ARMS platforms. Identification of these specimens

will involve the use of molecular and taxonomic practices. All specimens will be either frozen or preserved in ethanol or formalin. Those collected for the connectivity study will be processed at HIMB for molecular sequencing.

4.) N/A

5.) Water samples are brought back aboard the ship for initial processing, labeling and then kept frozen during transport. Once returned to Honolulu, both nutrient and chlorophyll samples are currently turned over to private contractors for analysis.

9c. Will the organisms be kept alive after collection? ☐ Yes ☒ No

No specimens will be kept alive except for any non-coral invertebrates that are brought onboard the ship for identification confirmation. If identified, these samples will be returned to the reef.

• General site/location for collections:

Generally all specimens collected will occur at or near the REA site locations. These exact positions will be provided in our compliance letter. If an opportunistic collection were to occur outside of these areas, the position will be noted and submitted within cruise reporting.

• Is it an open or closed system? ☐ Open ☒ Closed

The few invert specimens kept alive for identification then released are kept in a closed system before returning them the following day to the closest location of their removal.

• Is there an outfall? ☐ Yes ☒ No

No

• Will these organisms be housed with other organisms? If so, what are the other organisms?

No

• Will organisms be released?

No specimens will be kept alive except for any non-coral invertebrates that are brought onboard the ship for identification confirmation. If identified, these samples will be returned to the reef location where the collection took place.

10. If applicable, how will the collected samples or specimens be transported out of the Monument?

1.) Macroalgal samples will be frozen on pressed while on-board the ship, and taken back to Honolulu and the CRED phycology laboratory.

2.) In the ship's wet lab, coral tissue samples for histological studies will be fixed in zinc-formalin (Z-fix® Anatech Ltd) for 18-24 hours in plastic capped containers, and subsequently transferred to 70% ethanol. Samples will be stored in 70% ethanol in capped containers and transported to Honolulu. Waste product (i.e., formaldehyde fixing solution) will be stored for appropriate chemical disposal in Honolulu. Samples for Molecular studies will be preserved in Trizol and stored plastic capped containers in deep freeze and subsequently transported to Honolulu.

3.) Non-coral invertebrates will be removed from the reef with tweezers, shears, or by hand. Specimens will be placed in a mesh bag during the dive, transferred into small buckets upon surfacing, and then brought onboard the ship for identification confirmation. Only if the specimens are not identified then these samples will be preserved in ethanol or formalin in whirlpaks, microcentrifuge tubes, or glass and plastic jars. Specimens may also be placed in containers and frozen. Specimens saved for identification at Bishop Museum will be preserved in ways suitable for each taxonomic group. Porifera, molluscs, crustaceans, and echinoderms are to be preserved in 75% Ethanol or frozen, and soft-bodied organisms (cnidaria, sea slugs, and urochordates) will be preserved in 10% Formalin.

Collections for the connectivity studies involve subsampling from the targeted species; therefore, specimens are neither dead nor alive, rather it is a tissue portion. These subsamples will be preserved in ethanol or formalin in whirlpaks, microcentrifuge tubes, or glass and plastic jars. Specimens may also be placed in containers and frozen.

4.) N/A

5.) All water samples are frozen upon returning to the ship and stored in the scientific freezer until arrival in Honolulu.

11. Describe collaborative activities to share samples, reduce duplicative sampling, or duplicative research:

CRED collaborates with multiple agencies to minimize duplication and provides data to researchers and institutions interested in mutually beneficial collaboration. All attempts are made to incorporate these agencies and institutions in the research cruises and analysis of data.

1.) For macroalgae: herbarium pressings and slides will be deposited with pressed materials at the Bishop Museum, Honolulu, Hawaii or other research institutions after analyses are complete. Specimens of *Halimeda* for ocean acidification research will be shipped to Dr. Jennifer Smith's laboratory at Scripps Institution of Oceanography in San Diego for analysis. Microbial samples/rubble will be sent to Forest Rowher's lab at SDSU. SDSU or PIFSC is unaware of any other group that is collecting these types of samples or performing microbial analysis of the reef benthos.

2.) Data will be available in the cruise report which will be finished in a timely fashion after the conclusion of the cruise. Coral tissue samples will be sent out for histological processing, which will be conducted in collaboration with scientists Alison Moulding and Abby Renegar at Nova Southeastern University. Histological slides will be read and evaluated here in Honolulu, and later deposited in an appropriate institution. Additionally, in collaboration with scientists Michael Morgan and Sara Edge at Berry College, Georgia, and Harbor Branch, FL, respectively, RNA studies will be conducted on selected samples aimed at investigating the molecular responses that may be associated with the disease condition. Selected results from previous coral surveys conducted through Coral Reef Ecosystem Division in the Hawaiian archipelago have been presented as conference posters, oral presentations, national-level reports, and publications in refereed journals. It is similarly anticipated that important results stemming from research conducted under the requested permit in 2008 will be professionally disseminated within the national and international scientific community.

Taxonomic Records: Specimens will be sent or shared with other taxonomic experts for identification and/or description, and suitable samples deposited for reference in an appropriate institution post examination with collaborators (e.g., Bishop Museum, Honolulu).

3.) The analysis of non-coral invertebrates at Bishop Museum, Smithsonian, Florida Natural History Museum, CRED, L.A. County Museum, University of Hawaii at Hilo, San Diego State, Moss Landing Marine Laboratories, Scripps Oceanographic Institute, and HIMB will involve the use of molecular processing and taxonomic literature to make tentative identifications. These findings and the field identifications will be given to the appropriate agency representatives sponsoring the expedition in the form of a final report and species list. This is a lengthy process (1-2 years), and is dependent on funding and resources for this post-expedition processing.

4.) N/A

5.) The shallow water EARs (<30m) being serviced by CRED are in conjunction with the partnership with Whitlow Au who also has deployed deep water EARs (>30m). Our EAR lead at CRED, Mark Lammers, also works with Whitlow. The moorings to which the EARs are attached are CRED moorings that we alone deploy and replace. The EAR instrument on the mooring is typically replaced by CRED but periodically with assistance from partners like Whitlow or Carl Meyer they are replaced. The deployment locations are enclosed. The list of personnel diving to replace the EARs will be submitted with our Compliance Form. Servicing of EARs takes place in Honolulu.

12a. List all specialized gear and materials to be used in this activity:

Certified divers use NITROX to maximise bottom times for observations while following all strict NOAA Dive Center (NDC) dive regulations and adhering to Monument protocols. Standardized NDC dive gear is worn by divers who are familiar with their dive teams equipment (Mask, snorkel fins, wetsuit, booties, dive knife, buoyancy compensator devices, regulator, safety inflation indicator, dive whistle and personal dive safety equipment).

1.) Transect lines, underwater clipboard, underwater paper, pencils, PVC photoquadrat, camera with underwater housing, Ziploc bags, cooler.

2.) Transect lines, underwater clipboard, underwater paper, pencils, whirlpaks, cutting shears, hammer, chisel, camera with underwater housing, and cooler.

3.) Transect lines, underwater clipboard, underwater paper, pencils, shears, sledgehammer, zip ties, stainless steel stakes, cooler, 2.5 gal buckets, dive bag, 50 ml test tubes, whirlpaks and cameras with underwater housings.

4.) Transect lines, underwater clipboard, underwater paper, pencils and cameras with underwater housings.

5.) Lift bags, air tanks with nozzles, lines and clips, zip ties, cameras with underwater housings, wrenches, screw drivers, the various oceanographic arrays, CTD units and water sampling gear mentioned in the Methods section

12b. List all Hazardous Materials you propose to take to and use within the Monument:

The CRED uses very limited chemicals in the field while in the Monument. The majority of chemicals listed remain in the designated Hazmat lockers aboard the support vessel. The CRED Hazmat list contains all compounds from minor solutions like vinegar to the more caustic ones listed below. A complete version of the MSDS is attached as Appendix I:

- Clorox Bleach (Used for the cleaning of gear and instruments.)
- Ethanol (Used for the preservation of various samples.)
- Formalin (10%) (Used for the preservation of various samples.)
- Z-Fix Concentrate (Used for the fixation of various coral samples.)
- Mercuric Chloride Solution (A small amount, typically micro liters per sample, is used to halt biological activity in water samples. This is necessary for accurate analysis of dissolved inorganic carbon. The mercuric chloride solution is added to the water sample bottle after the sample is collected. The sample bottle is secured and brought back to port for later laboratory analysis. The mercuric chloride solution is not introduced into Monument waters.)
- 10,000X SYBR Gold nucleic acid gel stain (Used by the microbiologist to stain water sampling filters to allow counting of microbes and viruses.)
- DAPI (4',6-diamidino-2-phenylindole) (Used by the microbiologist to for staining of filters, facilitating cell size measurement.)
- 32% Paraformaldehyde (Used by the microbiologist to halt biological activity in water samples)
- HCl (33-40%) (Used by the microbiologist to remove dissolved inorganic carbon from water samples.)
- Glutaraldehyde (Used by the microbiologist to halt biological activity in water samples as part of the flow cytometry process.)
- Chloroform (Used by the microbiologist to purify genetic samples.)
- Liquid Nitrogen (Used by the microbiologist to freeze flow cytometry samples.)

13. Describe any fixed installations and instrumentation proposed to be set in the Monument:

1-3.) Permanent Transects: A number of permanent transects have been established at fixed sites during previous cruises, with the intention of providing georeferenced markers by which researchers can return to precise locations on subsequent cruises so as to re-survey the reef at known time intervals. Establishing a permanent transect involves manual installation of hardened stainless steel stakes (12 stakes/50m transect) on hard dead substrate, away from living corals. An underwater epoxy applicator is then used to better affix the stake to the substrate. Each stake measures 3/8th - inch diameter; similar stakes have been used successfully with no signs of corrosion over a 2-year period. All other equipment (hammers, epoxy applicators, transect tapes) will be removed from the reef at the completion of each survey. The majority of long-term monitoring sites to be visited already have permanent transects in place, and installation of any new pins at these sites will be for the purpose of repairing any missing pins. Occasionally a primary site is not able to be surveyed due to adverse weather conditions and an alternative site has been chosen. The permanent markers that would be installed during the 2010 cruise would be ≤ 60 .

3.) Replacement ARMS will be installed at the existing ARMS sites: Autonomous Reef Monitoring Structures (ARMS) were deployed in 2008 in relation to REA sites.

LIS: 9 ARMS (3 sites)

PHR: 15 ARMS (5 sites)

MID: 12 ARMS (4 sites)

MAR: 9 ARMS (3 sites)

KUR: 12 ARMS (4 sites)

FFS: 18 ARMS (6 sites)

ARMS are small, long-term collecting devices designed to mimic, to some degree, the structural complexity of a coral reef, thus attracting colonizing invertebrates over the period during which the ARMS are left in the field. Each of the ARMS measures 14 in by 18 in by 8 in., with 9 layers of plates .5 inches apart. To compare the biota between islands/atolls/regions three sites will be located on the forereef, and if applicable one site on a lagoon patch reef (3-4 sites per island/atoll with each site consisting of 3 ARMS- 63 total). The ARMS were placed on pavement or sand, in proximity to coral reef structures, specifically to avoid coral damage. The ARMS were deployed by divers using stainless steel stakes and weights to insure that they remain in place for the duration of 1-2 years. The current ARMS will be recovered and new ones will replace the old ones using the existing stakes at each position. A Global Positioning System (GPS) point is taken for each of the ARMS after deployment for accurate relocation. The Coral Reef Ecosystem Division of the Pacific Islands Fisheries Science Center will be responsible for maintaining and removing the installations during a follow-up cruise.

4.) N/A

5.) The capacity for early warning systems for oceanographic and biological phenomena along with a greater understanding of how the physical environment affects the dynamics of biological components of coral reef ecosystems can all be utilized in the resource management decision making process.

Maintenance and Longevity: The instrument arrays are conceived to be a long-term scientific feature. We plan to change out arrays every two years and maintain them when needed with the sites remaining consistent from year to year.

Techniques:

- **SST Replacement:** The SST replacements may involve lowering a new anchor (~250 lb block), rigged to its mooring system and buoy and removing the old anchor and mooring system and buoy. A lift bag will be used to slowly lower and raise the anchors and the new anchor will be set in the same spot as the old. Alternatively, if the existing anchor is in good shape (i.e. corrosion of the padeye and other components does not compromise the integrity of the anchor), the existing anchor will be left in place and only the old mooring system and buoy will be replaced.
- **WTR and EAR Replacement:** The WTR and EAR replacements will involve lowering a new anchor with the instrumentation in place and recovering the old anchor and instrument. A lift bag will be used to slowly lower and raise the system and the new anchor will be set in the same spot as the old. Alternatively, if the existing anchor is in good shape, the existing anchor will be left in place and only the instrument will be changed-out.
- **CAU Installation:** Up to 10 REA sites at each island/atoll visited will be selected for CAU installation. Each CAU site will consist of 5 deployed CAU units.
- **STR Replacement:** The STR replacements will involve swimming a new anchor and instrument to the site, removing the old anchor, instrument and mooring ties and installing a new system with fresh mooring ties at the same site.

14. Provide a time line for sample analysis, data analysis, write-up and publication of information:

A Hawaiian Archipelago cruise report containing data collected in the field will be completed and submitted to PMNM within 6 months from the completion of the cruise. The PMNM cruise completion report will also be completed and submitted according to PMNM guidelines and requirements.

15. List all Applicants' publications directly related to the proposed project:

1.) Relevant Publications:

Abbott, I.A. 1999. Marine Red Algae of the Hawaiian Islands. Bishop Museum Press, Honolulu, Hawai'i, 477 pp.

Abbott, I.A. and J. M. Huisman. 2004. Marine Green and Brown Algae of the Hawaiian Islands. Bishop Museum Press, Honolulu, Hawai'i, 259 pp.

Brainard, Rusty, Jim Maragos, Robert Schroeder, Jean Kenyon, Peter Vroom, Scott Godwin, Ronald Hoeke, Greta Aeby, Russell Moffitt, Marc Lammers, Jamison Gove, Molly Timmers, Stephani Holzwarth, Steve Kolinski (2005) Status of the coral reef ecosystems of the U.S. Pacific Remote Island Areas. In: The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2005. [ed. Jenny E. Waddell]. NOAA Technical Memorandum NOS NCCOS II. NOAA/NCCOS Center for Coastal Monitoring and Assessments Biogeography Team, Silver Spring, MD.

Braun, Cristi L., Jennifer E. Smith, Peter S. Vroom (2009) Examination of algal diversity and benthic community structure at Palmyra Atoll, U.S. Line Islands. /Proceedings of the XIth International Coral Reef Symposium/. 1: 865-869.

Friedlander, Alan, Greta Aeby, Rusty Brainard, Athline Clark, Edward DeMartini, Scott Godwin, Jim Maragos, Jean Kenyon, Randy Kosaki, Peter Vroom (2005) Status of the coral reef ecosystems of the Northwestern Hawaiian Islands. In: The State of Coral Reef Ecosystems of the United States and Pacific Freely Associated States: 2005. [ed. Jenny E. Waddell]. NOAA Technical Memorandum NOS NCCOS II. NOAA/NCCOS Center for Coastal Monitoring and Assessments Biogeography Team, Silver Spring, MD.

Friedlander, Alan, Greta Aeby, Russell Brainard, Eric Brown, Athline Clark, Steve Coles, Edward DeMartini, Steve Dollar, Scott Godwin, Cindy Hunter, Paul Jokiel, Jean Kenyon, Randy Kosaki, Jim Maragos, Peter Vroom, Bill Walsh, Ivor Williams, Wendy Wiltse (2004) Status of Coral Reefs in the Hawaiian archipelago. In: Status of Coral Reefs of the World: 2004. Volume 2 [ed. Clive Wilkinson]. Australian Institute of Marine Science, Townsville, Queensland, Australia, pp. 411-430.

Kenyon, Jean C., Peter S. Vroom, Kimberly N. Page, Matthew J. Dunlap, Casey B. Wilkinson, Greta S. Aeby (2006) Community structure of hermatypic corals at French Frigate Shoals, Northwestern Hawaiian Islands: capacity for resistance and resilience to selective stressors. Pacific Science 60: 153-175.

Kolinski, Steven P., Ronald K. Hoeke, Stephani R. Holzwarth, Peter S. Vroom (2005) Sea turtle abundance at isolated reefs of the Mariana archipelago. Micronesica 37: 287-296.

Preskitt, Linda B., Peter S. Vroom, Celia M. Smith (2004) A rapid ecological assessment (REA) quantitative survey method for benthic algae using photo quadrats with SCUBA. Pacific Science 58: 201-209.

Tsuda, Roy T., Jack R. Fisher, Peter S. Vroom, Isabella A. Abbott (2010) New records of subtidal benthic marine algae from Wake Atoll, Central Pacific. /Botanica Marina/. 53: 19-29.

Tsuda, Roy T., Peter S. Vroom, Isabella A. Abbott, Jack R. Fisher, Kevin B. Foster (2008) Additional marine benthic algae from Howland and Baker Islands, Central Pacific. Pacific Science 62: 271-290.

Tribollet, Aline D., Peter S. Vroom (2007) Temporal and spatial comparison of the relative abundance of macroalgae across the Mariana archipelago between 2003 and 2005. Phycologia. 46: 187-197.

Vroom, Peter S., Kimberly N. Page, Jean C. Kenyon, Russell E. Brainard (2006) Algae-Dominated Reefs. *American Scientist* 94: 429-437.

Vroom, Peter S., Cristi L. Braun (2010) What is the benthic composition of a healthy subtropical reef? Baseline species-level percent cover, with an emphasis on reef algae, in the Northwestern Hawaiian Islands. */Plos One/* 5: e9733. DOI 10.1371/journal.pone.0009733

Vroom, Peter S., Craig A. Musburger, Susan W. Cooper, James E. Maragos, Kimberly N. Page-Albins, and Molly A.V. Timmers (2010) Marine biological community baselines in unimpacted tropical ecosystems: Spatial and temporal analyses of reefs at Howland and Baker Islands. */Biodiversity and Conservation.* /19: 797-812./ / DOI 10.1007/s10531-009-9735-y

Vroom, Peter S., Jacob Asher, Cristi L. Braun, Edmund Coccagna, Oliver J. Vetter, Wendy A. Cover, Kristin M. McCully, Donald C. Potts, Amarisa Marie, Cynthia Vanderlip (2009) Macroalgal (*/Boodlea composita/*) bloom at Kure and Midway Atolls, Northwestern Hawaiian Islands. */Botanica Marina* /52: 361-363.

Vroom, Peter S., Molly A.V. Timmers (2009) Spatial and temporal comparison of algal biodiversity and benthic cover at Gardner Pinnacles, Northwestern Hawaiian Islands. */Journal of Phycology* /45: 337-347.

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Vroom, Peter S., Kimberly N. Page, Kimberly A. Peyton, J. Kanekoa Kukea-Shultz (2005) Spatial heterogeneity of benthic community assemblages with an emphasis on reef algae at French Frigate Shoals, Northwestern Hawaiian Islands. *Coral Reefs* 24: 574-581.

Vroom, Peter S., Kimberly N. Page, Kimberly A. Peyton, J. Kanekoa Kukea-Shultz (2006) Marine algae of French Frigate Shoals, Northwestern Hawaiian Islands: Species list and biogeographic comparisons. *Pacific Science* 60: 81-95.

Vroom, Peter S. (2005) *Dasya atropurpurea* sp. nov. (Ceramiales, Rhodophyta), a deep water species from the Hawaiian archipelago. *Phycologia* 44: 572-580.

Vroom, Peter S., Isabella A. Abbott (2004) *Scinaia huismanii* sp. nov. (Nemaliales, Rhodophyta): an addition to the exploration of the marine algae of the northwestern Hawaiian Islands. *Phycologia* 43: 445-454.

Vroom, Peter S., Isabella A. Abbott (2004) *Acrosymphyton brainardii* sp. nov. (Gigartinales, Rhodophyta) from French Frigate Shoals, Northwestern Hawaiian Islands. *Phycologia* 43: 68-74.

Vroom, Peter S., Celia M. Smith (2003) Reproductive features of Hawaiian *Halimeda velasquezii* (Bryopsidales, Chlorophyta), and an evolutionary assessment of reproductive characters in *Halimeda*. *Cryptogamie, Algologie* 24: 355-370.

Vroom, Peter (2003) Paradise examined. *Arches, University of Puget Sound Alumni Magazine* 30 (4): 12-13.

Vroom, Peter S., Celia M. Smith (2003) Life without cells. *Biologist* 50: 222-226.

Vroom, Peter (2002) Algal studies. In: Coral Reef Ecosystems of the Northwestern Hawaiian Islands (eds. James Maragos and David Gulko), pp.18-19. U. S. Fish and Wildlife Service and the Hawai'i Department of Land and Natural Resources, Honolulu, Hawai'i.

2.) Aeby, G. S. 2006. Baseline levels of coral disease in the Northwestern Hawaiian Islands. *Atoll Res. Bull.* 534: 471-488.

Ben-Haim, Y., F.L. Thompson, C.C. Thompson, M.C. Cnockaert, B. Hoste, J. Swings, and E. Rosenberg. 2003. *Vibrio coralliilyticus* sp. nov., a temperature dependent pathogen of the coral *Pocillopora damicornis*. *Int. J. of Syst. & Evol. Microbio* 53: 309-315.

Bythell J, D. Pantos, L. Richardson. 2004. White plague, white band, and other "white diseases". Pages 351-365 In: Rosenberg E, Loya Y (eds) *Coral Health and Disease*, Springer-Verlag, Berlin, 488 p.

Golbuu, Y., A. Barman, J. Kuartei, and S. Victor. 2005. The state of the coral reef ecosystems of Palau. Pages 488-507 in J. Waddell, ed. *The state of the coral reef ecosystems of the United States and Pacific Freely Associated States: 2005*. NOAA Technical Memorandum NDS NCCOS 11. NOAA/NCCOS Center for Coastal Monitoring and Assessment's Biogeography Team. Silver Spring, MS, 552pp.

Harvell, C. D., R. Aronson, N. Baron, J. Connell, A. Dobson, S. Ellner, L. Gerber, K. Kim, A. Kuris, H. McCallum, K. Lafferty, B. McKay, J. Porter, M. Pascual, G. Smith, K. Sutherland, and J. Ward. 2004. The rising tide of ocean diseases: unsolved problems and research priorities. *Front. Ecol. Environ.* 2:375-382.

Kaczmarzky, L. T. 2006. Coral disease dynamics in the central Philippines. *Dis. Aquat. Org.* 69:9-21.

Loya, Y. 2004. The coral reefs of Eilat- past, present and future: three decades of coral community structure studies. Pages 1-34 in E. Rosenberg and Y. Loya, eds. *Coral Health and Disease*, Springer-Verlag, Berlin, 488 pp.

Porter, J., P. Dustan, W. Jaap, K. Patterson, V. Kosmynin, D. Meier, M. Patterson, and M. Parsons. 2001. Patterns of spread of coral disease in the Florida Keys. *Hydrobiology* 159: 1-24.

Sutherland, K. P., J. Porter, and C. Torres. 2004. Disease and immunity in the Caribbean and Indo-Pacific zooxanthellate corals. *Marine Ecol. Prog. Ser.* 266:273-302.

Vargas-Ángel, B., E. C. Peters, E. Kramarsky-Winter, D. Gilliam, and D.E. Dodge. 2007. Cellular reactions to sedimentation and temperature stress in the Caribbean coral *Montastraea cavernosa*. *J. Invertebr. Pathol.* 95:140-145.

Vargas-Ángel, B., J.C. Kenyon, J. Maragos, and R.E. Brainard. In prep. Ecological assessment of coral diseases in the US Pacific Remote Island Areas.

Weil, E., G. Smith, and D. L. Gil-Agudelo. 2006. Status and progress in coral disease research. *Dis. Aquat. Org* 69: 1-7.

Willis, B. L., C. Page, and E. Dinsdale. 2004. Coral Diseases on the Great Barrier Reef. Pages 69-104 in E. Rosenberg and Y. Loya, eds. *Coral Health and Disease*, Springer-Verlag, Berlin, 488pp.

3.) Asakura, A. and L.S. Godwin. 2005. A new species of hermit crab (Crustacea, Decapoda, Anomura, Diogenidae) of the genus *Dardanus* from the U.S. Equatorial Islands. *Zootaxa*. (In prep).

Asakura, A. and L.S. Godwin. 2005. *Diogenes macLaughlinae*, a new species of hermit crab (Crustacea, Decapoda, Anomura, Diogenidae) from American Samoa. *Invertebrate Taxonomy* (In prep).

Brainard, R.E., et al. 2007. Coral Reef Ecosystem Monitoring Report for American Samoa: 2002-2006. NOAA-PIFSC, Honolulu.

Castro, P. and L.S. Godwin. 2005. The first records in the Hawaiian Archipelago for two genus of crab from the family Trapeziidae. *Bishop Museum Occasional Papers* (In press).

DeFelice, R., D. Minton and L.S. Godwin. 2002. Records of the shallow-water marine invertebrates from French Frigate Shoals, Northwestern Hawaiian Islands, with a note on non-indigenous species.

Godwin, L.S. 2003. Coral Reef Ecosystem Division Cruise OES-03-06, Northwestern Hawaiian Islands, Marine Invertebrates, Cruise report to NOAA, NMFS, Coral Reef Ecosystem Division.

Godwin, L.S. 2002. Coral Reef Ecosystem Investigation Cruise TC-02-07, Northwestern Hawaiian Islands, Marine Invertebrates, Cruise report to NOAA, NMFS, Coral Reef Ecosystem Investigation.

Godwin, L.S. 2002. Rapid ecological assessment of the marine invertebrate fauna of American Samoa and the U.S. Phoenix and Line Islands. Preliminary report Submitted to the NOAA National Marine Fisheries Service, Honolulu Laboratory, Coral Reef Ecosystem Investigation.

Zimmerman, T. L., and J. W. Martin. 2004. Artificial reef matrix structures (ARMS): an inexpensive and effective method for collecting coral reef-associated invertebrates. *Gulf and Caribbean Research* 16:59-64.

4.) Brainard, R.E., et al. 2007. Coral Reef Ecosystem Monitoring Report for American Samoa: 2002-2006. NOAA-PIFSC, Honolulu.

Schroeder, R.E., A. Green, E.E. DeMartini, J. Kenyon. (in review). Long-term effects of a ship-grounding on coral reef fish assemblages at Rose Atoll, American Samoa.

5.) Brainard, R.E., et al. 2007. Coral Reef Ecosystem Monitoring Report for American Samoa: 2002-2006. NOAA-PIFSC, Honolulu.

With knowledge of the penalties for false or incomplete statements, as provided by 18 U.S.C. 1001, and for perjury, as provided by 18 U.S.C. 1621, I hereby certify to the best of my abilities under penalty of perjury of that the information I have provided on this application form is true and correct. I agree that the Co-Trustees may post this application in its entirety on the Internet. I understand that the Co-Trustees will consider deleting all information that I have identified as "confidential" prior to posting the application.

Signature

Date

**SEND ONE SIGNED APPLICATION VIA MAIL TO THE MONUMENT OFFICE
BELOW:**

Papahānaumokuākea Marine National Monument Permit Coordinator
6600 Kalaniana'ole Hwy. # 300
Honolulu, HI 96825
FAX: (808) 397-2662

DID YOU INCLUDE THESE?

- ☒ Applicant CV/Resume/Biography
- ☐ Intended field Principal Investigator CV/Resume/Biography
- ☒ Electronic and Hard Copy of Application with Signature
- ☒ Statement of information you wish to be kept confidential
- ☒ Material Safety Data Sheets for Hazardous Materials

Appendix 1

Seventy-five pacific scleractinian species that have been petitioned by the Center for Biological Diversity to be listed under the Endangered Species Act (ESA).

<i>Acanthastrea brevis</i>	<i>Acropora verweyi</i>	<i>Montipora caliculata</i>
<i>Acanthastrea hemprichii</i>	<i>Alveopora allingi</i>	<i>Montipora dilatata</i>
<i>Acanthastrea ishigakiensis</i>	<i>Alveopora fenestrata</i>	<i>Montipora flabellate</i>
<i>Acanthastrea regularis</i>	<i>Alveopora verrilliana</i>	<i>Montipora lobulata</i>
<i>Acropora aculeus</i>	<i>Anacropora puertogalerae</i>	<i>Montipora patula</i>
<i>Acropora acuminata</i>	<i>Anacropora spinosa</i>	<i>Pachyseris rugosa</i>
<i>Acropora aspera*</i>	<i>Astreopora cucullata</i>	<i>Pavona bipartite</i>
<i>Acropora dendrum</i>	<i>Barabattoia laddi</i>	<i>Pavona cactus</i>
<i>Acropora donei</i>	<i>Caulastrea echinulata</i>	<i>Pavona decussata</i>
<i>Acropora globiceps</i>	<i>Cyphastrea agassizi</i>	<i>Pavona diffluens</i>
<i>Acropora horrida</i>	<i>Cyphastrea ocellina</i>	<i>Pavona venosa</i>
<i>Acropora jacquelineae</i>	<i>Euphyllia cristata</i>	<i>Pectinia alcornonis</i>
<i>Acropora listeri</i>	<i>Euphyllia paraancora</i>	<i>Physogyra lichtensteini</i>
<i>Acropora lokani</i>	<i>Euphyllia paradivisa</i>	<i>Pocillopora danae</i>
<i>Acropora microclados</i>	<i>Galaxea astreata</i>	<i>Pocillopora elegans</i>
<i>Acropora palmerae</i>	<i>Heliopora coerulea</i>	<i>Porites horizontalata</i>
<i>Acropora paniculata</i>	<i>Isopora crateriformis</i>	<i>Porites napopora</i>
<i>Acropora pharaonis</i>	<i>Isopora cuneata</i>	<i>Porites nigrescens</i>
<i>Acropora polystoma</i>	<i>Leptoseris incrustans</i>	<i>Porites pukoensis</i>
<i>Acropora retusa</i>	<i>Leptoseris yabei</i>	<i>Psammocora stellata</i>
<i>Acropora rudis</i>	<i>Millepora foveolata</i>	<i>Seriatopora aculeata</i>
<i>Acropora speciosa</i>	<i>Millepora tuberosa</i>	<i>Turbinaria mesenterina</i>
<i>Acropora striata</i>	<i>Montipora angulata</i>	<i>Turbinaria peltata</i>
<i>Acropora tenella</i>	<i>Montipora australiensis</i>	<i>Turbinaria reniformis</i>
<i>Acropora vauhani</i>	<i>Montipora calcarea</i>	<i>Turbinaria stellulata</i>

Papahānaumokuākea Marine National Monument Compliance Information Sheet

1. Updated list of personnel to be covered by permit. List all personnel names and their roles here (e.g. John Doe, Diver; Jane Doe, Field Technician, Jerry Doe, Medical Assistant):

<i>Name</i>	<i>Position</i>	<i>Affiliation</i>
Peter Vroom	Chief Scientist, Diver	Ocean Assoc.
Kaylyn McCoy	REA Fish Diver	JIMAR
Paula Ayotte	REA Fish Diver	JIMAR
Mark Manuel	REA Fish Diver	JIMAR
Hailey Ramey	REA Fish Diver	JIMAR
Erin Looney	Coral Disease Diver	JIMAR
Jason Helyer	Coral Populations Diver	JIMAR
Scott Godwin	Invertebrates Diver	PMNM
Kerry Grimshaw	Invertebrates (ARMS) Diver	JIMAR
Rodney Withall	Lead Phycologist	JIMAR
Cristi Richards	Assistant Phycologist	JIMAR
Benjamin Richards	Fish Towed-Diver	JIMAR
Marie Ferguson	Fish Towed-Diver	JIMAR
Edmund Coccagna	Benthic Habitat Towed-Diver	JIMAR
Jeff Anderson	Benthic Habitat Towed-Diver	JIMAR
Jamison Gove	Oceanography/Mooring Diver	JIMAR
Frank Mancini	Oceanography/Mooring Diver	JIMAR
Russell Reardon	Oceanography/Mooring Diver	JIMAR
Daniel Merritt	Oceanography/Mooring Diver	JIMAR
TBD	Oceanography Diver	SDSU
James Bostick	Divemaster/Chamber Operator	NOAA
Annette DesRochers	Data Manager	JIMAR

2. Specific Site Location(s): (Attach copies of specific collection locations):

Please see *Appendix A* for anticipated collection locations for each team. A subset of these sites will be visited as follows: Approximately 66 long-term rapid ecological assessments (REA) sites, an additional ~160 fish REA sites, ~10 permanent CTD station sites, ~ 25 Autonomous Reef Monitoring Structures (ARMS) sites, and ~35 Calcification Acidification Units (CAU) sites. In addition, towed diver surveys will be conducted in the shallow water habitats around each island, bank, or reef. Existing oceanographic instruments will be serviced.

3. Other permits (list and attach documentation of all other related Federal or State permits):

The Papahānaumokuākea Marine National Monument Research Permit should cover all planned research activities.

3a. For each of the permits listed, identify any permit violations or any permit that was suspended, amended, modified or revoked for cause. Explain the circumstances surrounding the violation or permit suspension, amendment, modification or revocation.
N/A.

4. Funding sources (Attach copies of your budget, specific to proposed activities under this permit and include funding sources. See instructions for more information):

The multi-year reef assessment and monitoring program (RAMP) is supported by the NOAA Coral Reef Conservation Program (<http://coralreef.noaa.gov/>), NOAA Pacific Islands Fisheries Science Center, and the NOAA Office of Marine and Aviation Operations.

5. Time frame:

Activity start: August 27, 2010

Activity completion: September 30, 2010

Note: CRED aspires to continue biennial reef assessment and monitoring of the Papahānaumokuākea Marine National Monument as part of the Pacific Reef Assessment and Monitoring Program (RAMP).

Dates actively inside the Monument:

From: August 28, 2010

To: September 29, 2010

Describe any limiting factors in declaring specific dates of the proposed activity at the time of application: N/A

Personnel schedule in the Monument:

The 22 participating personnel listed in Question #1 will be working in the shallow water reefs (<30m) of the Monument including the reefs associated with: Kure Atoll, Pearl & Hermes Atoll, Midway Atoll, French Frigate Shoals, Lisianski Island, Laysan Island, Nihoa Island, Necker Island, Gardner Pinnacles and Maro Reef.

6. Indicate (with attached documentation) what insurance policies, bonding coverage, and/or financial resources are in place to pay for or reimburse the Monument trustees for the necessary search and rescue, evacuation, and/or removal of any or all persons covered by the permit from the Monument:

NOAA ships and the activities conducted off of them are to be considered self-insured by the federal government.

7. Check the appropriate box to indicate how personnel will enter the Monument:

- ☒ Vessel
☐ Aircraft

Provide Vessel and Aircraft information: NOAA Ship *Hi'ialakai*.

8. The certifications/inspections (below) must be completed prior to departure for vessels (and associated tenders) entering the Monument. Fill in scheduled date (attach documentation):

N/A, the NOAA Ship *Hi'ialakai* will provide this information directly to the Papahānaumokuākea Marine National Monument.

- ☐ Rodent free, Date:
☐ Tender vessel, Date:
☐ Ballast water, Date:
☐ Gear/equipment, Date:
☐ Hull inspection, Date:

9. Vessel information (NOTE: if you are traveling aboard a National Oceanic and Atmospheric Administration vessel, skip this question): N/A.

Vessel name:

Vessel owner:

Captain's name:

IMO#:

Vessel ID#:

Flag:

Vessel type:

Call sign:

Embarkation port:

Last port vessel will have been at prior to this embarkation:

Length:

Gross tonnage:

Total ballast water capacity volume (m3):

Total number of ballast water tanks on ship:

Total fuel capacity:

Total number of fuel tanks on ship:

Marine Sanitation Device:

Type:

Explain in detail how you will comply with the regulations regarding discharge in the Monument. Describe in detail. If applicable, attach schematics of the vessel's discharge and treatment systems:

Other fuel/hazardous materials to be carried on board and amounts:

Provide proof of a National Oceanic and Atmospheric Administration (NOAA) Office of Law Enforcement-approved Vessel Monitoring System (VMS). Provide the name and contact information of the contractor responsible for installing the VMS system. Also describe VMS unit name and type:

VMS Email:

Inmarsat ID#:

10. Tender information:

On what workboats (tenders) will personnel, gear and materials be transported within the Monument? List the number of tenders/skiffs aboard and specific types of motors:

1. HI-1, 10-m Ambar jet boat; Yanmar Engine, 6-cylinder, 375 HP/diesel.
2. HI-2, 8-m Ambar jet boat; Yanmar Engine, 6-cylinder, 315 HP/diesel.
3. HI-3, 5.2-m North Wind Rigid Hull Boat (RHB); Honda Engine, 90 HP/ unleaded.
4. HI-4 (Rescue Boat only), 5.3-m Ambar Jet boat; Honda Engine, 115 HP/unleaded.
5. HI-7, 5.3-m Zodiac Inflatable boat; Honda Engine, 50 HP/unleaded.
6. PIFSC 6-m SAFE Boat; two Honda Engines, 90 HP/unleaded
7. PIFSC 6-m SAFE Boat; two Honda Engines, 90 HP/unleaded
8. CRED 5.3-m AVON Rigid Hull Inflatable boat (RHIB); Honda 50 HP tiller.

Additional Information for Land Based Operations

11. Proposed movement of personnel, gear, materials, and, if applicable, samples: N/A

12. Room and board requirements on island: N/A

13. Work space needs: N/A

DID YOU INCLUDE THESE?

- ☒ Map(s) or GPS point(s) of Project Location(s), if applicable
- ☐ Funding Proposal(s)
- ☐ Funding and Award Documentation, if already received
- ☐ Documentation of Insurance, if already received
- ☐ Documentation of Inspections
- ☐ Documentation of all required Federal and State Permits or applications for permits